DME
BENCH TEST SET
578D-1

INSTRUCTION BOOK

COLLINS RADIO COMPANY

COLLINS®

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(E) Nature of trouble
(F) Cause of trouble if known
(G) Part number (9 or 10 digit number) and name of part thought to be causing trouble
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(B) Collins part number (9 or 10 digit number) and description
(C) Item or symbol number obtained from parts list or schematic
(D) Collins type number, name and serial number of principal equipment
(E) Unit subassembly number (where applicable)

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SECTION I
GENERAL DESCRIPTION

1.1 PURPOSE OF INSTRUCTION BOOK.

This instruction book contains information for installing, operating, and maintaining DME Bench Test Set 578D-1 as shown in figure 1-1.

1.2 PURPOSE OF EQUIPMENT.

DME Bench Test Set 578D-1 is used with the Boonton Radio Company 235-A Navigation Aids Test Set for complete bench testing and aligning of distance measuring equipment (DME) which is in accord with ARINC Characteristic 521B dated August 12, 1957.

The 578D-1 provides all video signals required for reply to distance measuring equipment. All control functions and a distance readout for DME are included in the 578D-1. The control functions include channel selection, search limit control, and power control. Four video outputs are provided.

a. REPLY OUTPUT. This output provides a DME reply signal for the modulator of the Boonton Radio Company 235-A Navigation Aids Test Set.

b. SYNC OUTPUT. Synchronizing pulses are provided for synchronizing an oscilloscope to the DME interrogation pulse (after decoding), squitter pulses, identification tone, or the first reply pulse from the 578D-1.

c. CAL OUTPUT. This output supplies a calibration signal to an oscilloscope for adjusting the frequency of the oscillators of the 578D-1. This output also supplies a calibration signal which is used for adjusting the zero delay of the 578D-1 and the 235-A.

d. SUPPRESSOR OUTPUT. This output supplies a pulse to suppress the DME range pulses.

1.3 EQUIPMENT SUPPLIED.

Table 1-1 lists the equipment supplied with the DME Bench Test Set 578D-1.

TABLE 1-1. EQUIPMENT SUPPLIED

EQUIPMENT	QUANTITY	DESCRIPTION	COLLINS PART NUMBER	CABLE MARKER CODE
578D-1	1	DME Bench Test Set	522-1838-006	
Power cord	1	3 conductor 60 cps	426-5041-00	
Connector	1	Female, 3 conductor 400 cps	368-0005-00	
Connector	1	Female, 2 conductor 28 volts d-c	368-0010-00	
Cable	1	Multiconductor	547-2028-00	
Adapter	1	115 volts 60 cps	368-0110-00	
Cable no. 1	1	RG62A/U, 6 ft	547-2006-00	Red
Cable no. 2	1	RG62A/U, 6 ft	547-2007-00	Green
Cable no. 3	1	RG62A/U, 6 ft	547-2008-00	Orange
Cable no. 4	1	RG62A/U, 6 ft	547-2009-00	Tan
Cable no. 5	1	RG62A/U, 6 ft	547-2010-00	Silver
Cable no. 6	1	RG62A/U, 6 ft	547-2011-00	Blue
Cable no. 7	1	RG62A/U, 2 ft	547-2012-00	White
Cable no. 8	1	RG62A/U, 2 ft	547-2013-00	Yellow

Note: All color-coded cables are equipped with 260C/U series BNC plug connectors at each end.

1.4 EQUIPMENT REQUIRED BUT NOT SUPPLIED.

Table 1-2 lists the equipment or equivalents required but not supplied with the 578D-1.

TABLE 1-2
EQUIPMENT REQUIRED BUT NOT SUPPLIED

EQUIPMENT	MANUFACTURER AND TYPE
Signal Generator	Boonton 235-A
Oscilloscope, Dual Trace	Tektronix 545 with dual trace plug-in head.

In addition to the equipments listed in table 1-2, the following power sources are required for testing DME.

115, 220, or 230 volts, 60 cps, single phase.
115 volts, 400 cps, single phase (for DME).
27.5 volts, d-c (for DME).

1.5 OUTPUT CHARACTERISTICS.

1.5.1 REPLY OUTPUT (J-2).

Output impedance . . . . . 150 ohms.

Amplitude . . . . . Not less than 25 volts.

Repetition rates

Fixed or variable distance replies (without squitter) . . . . . 21 and 144 pulse pairs per second.

Identification . . . . . 1350 pps ±2 percent.

Squitter rates . . . . . 700 to 770 and 2700 pps ±5 percent.

Rise time . . . . . 0.3 usec maximum.

Decay time . . . . . 0.2 usec maximum.

Pulse width (50-percent points) . . . . . 3.5 ±0.5 usec.

Pulse pair spacing . . . . . 6, 9, 11.5, 12, 12.5, 15, 16, and 17.5 microseconds or single pulse output. All spacings ±0.1 microsecond except 6.0 microseconds ±0.5 microsecond.

Polarity . . . . . Positive.

Reply efficiency . . . . . Normal 70 percent ±10 percent.
Low 50 percent ±10 percent.

Distance simulation

Fixed . . . . . 0 through 198 miles in 18-mile steps.

Variable . . . . . -1 through 200 at variable rate 0 to 3000 knots (inbound or outbound, in 3 distance segments).

Distance accuracy . . . . . ±0.04 +0.1 mile of selected distance.
(Fixed distance replies)
Zero delay measured from second pulse of DME interrogation pair to second reply pulse from Boonton 235-A.

1.5.2 IDENTIFICATION OUTPUT (J-3).

Frequency . . . . . 1350 cps ±2 percent.

Power output . . . . . 50 mw across 500 ohms (with Collins 860E-1 DME).

1.5.3 CALIBRATION OUTPUT (J-6).

CAL ZERO position.

Polarity . . . . . Positive.

Prf . . . . . 19.696 kc ±0.02 percent.

Rise time . . . . . 0.2 usec maximum.

Pulse width . . . . . 0.8 usec maximum.

Amplitude . . . . . 50 volts minimum.

Impedance . . . . . 1 megohm.

CAL AMP position.

Wave shape . . . . . Pulsed sine wave (period approx 3000 usec).

Frequency . . . . . 44.95 kc ±0.02 percent.

Amplitude . . . . . 0.8 volt peak to peak minimum.

Impedance . . . . . 1 megohm.

CAL FREQ position.

Wave shape . . . . . Sine wave (continuous).

Frequency . . . . . 44.95 kc ±0.02 percent.

Amplitude . . . . . 4 volts peak to peak minimum.

Impedance . . . . . 1 megohm.

OPERATE position . . . . . No output.

.5.4 SYNCHRONIZATION OUTPUT (J-5).

CAL ZERO and CAL AMP position.

Polarity . . . . . Positive.

Prf . . . . . 150 ±40 pps.

Rise time . . . . . 0.2 usec maximum.

Pulse width . . . . . 1.3 ±0.3 usec.

Amplitude . . . . . 80 volts minimum.

Impedance . . . . . 1 megohm.

CAL FREQ position.

Wave shape . . . . . Sine wave (continuous).

Frequency . . . . . 89.903 kc ±0.02 percent.

Amplitude . . . . . 7 volts peak to peak minimum.

Impedance . . . . . 1 megohm.

OPERATE position with SYNC SELECTOR in SQUITTER position.

Polarity . . . . . Positive.

Rise time . . . . . 0.3 usec maximum.

Pulse width . . . . . 1.3 ±0.3 usec.

Amplitude . . . . . 10 volts minimum.

Prf . . . . . 700 to 770, 2700 pps ±5 percent, and 1350 pps ±2 percent.

Impedance . . . . . 1 megohm.

NOTE

There is no output when the selected SQUITTER RATE is 0.

OPERATE position with SYNC SELECTOR in INTERR position.

Prf . . . . . 21 and 144 pulses per second.

Rise time . . . . . 0.15 usec maximum.

Pulse width . . . . . 1.3 ±0.3 usec.

Amplitude . . . . . 8 volts minimum.

Impedance . . . . . 1 megohm.

OPERATE position with SYNC SELECTOR in REPLY position.

Prf . . . . . 21 or 144 pps.

Rise time . . . . . 0.15 usec maximum.

Pulse width . . . . . 1.0 usec ±0.3 usec.

Amplitude . . . . . 10 volts minimum.

Impedance . . . . . 1 megohm.

1.5.5 COUNTER STOP OUTPUT (J-8).

CAL ZERO or CAL AMP position.

Prf . . . . . 150 ±40 pps.

Rise time . . . . . 0.3 usec maximum.

Pulse width . . . . . 1.0 ±0.3 usec.

Amplitude . . . . . 6 volts minimum.

Impedance . . . . . 237 kilohms.

NOTE

In CAL FREQ or OPERATE positions, there is no output.

1.5.6 SUPPRESSOR OUTPUT.

CAL ZERO or CAL AMP position.

Prf . . . . . 150 ±40 pps.

Rise time . . . . . 2.0 usec maximum.

Decay time . . . . . 3.5 usec maximum.

Pulse width . . . . . 20 usec minimum.

Amplitude . . . . . 0 to 57 volts.

Impedance . . . . . 2000 ohms.

OPERATE position.

Prf . . . . . 21 and 144 pps.

Rise time . . . . . 2.0 usec maximum.

Decay time . . . . . 3.5 usec maximum.

Pulse width . . . . . 20 usec minimum.

Amplitude . . . . . 0 to 57 volts.

Impedance . . . . . 2000 ohms.

NOTE

In CAL FREQ position there is no output.

1.6 GENERAL CHARACTERISTICS.

Type of service . . . . . Attended, local, and continuous.

Dimensions . . . . . 19 x 10-15/32 x 17 inches.

Weight . . . . . 33 lb.

Type of construction . . . . . Semiportable, and nonpressurized.

Cooling . . . . . Convection.

Type mounting . . . . . Standard 19-inch relay rack.

Ambient temperature range . . . . . 14°F (-10°C) to 131°F (55°C).

Ambient humidity range . . . 10 to 90 percent at 122°F (50°C).

Altitude . . . . . 10,000 feet.

Power source . . . . . 115, 220, or 230 volts, 60 cps single phase.

Power source (for DME under test) . . . . . 115 volts 380-420 cps single phase and 27.5 volts d-c.

Power requirements . . . . . 115 volts a-c, 142 va.

1.7 VACUUM TUBE, DIODE, CRYSTAL, AND FUSE COMPLEMENT.

Table 1-3 lists the vacuum tubes used in the 578D-1, table 1-4 lists the diodes used in the 578D-1, table 1-5 lists the crystals used in the 578D-1, and table 1-6 lists the fuses used in the 578D-1.

TABLE 1-3. VACUUM TUBE COMPLEMENT

ITEM NUMBER	TUBE TYPE	FUNCTION
V1	12AU7	Decoder amplifiers
V2	12AT7	Decoder pulse shaping amplifiers
V3	12AT7	Decoder blocking oscillator
V4A	1/2 12AT7	Delayed trigger generator
V4B	1/2 12AT7	Trigger amplifier
V5	12AU7	Range gate generator
V6	12AU7	Gated oscillator
V7	6AU6	Trigger generator
V8A	1/2 12AT7	Range pulse generator
V8B	1/2 12AT7	Oscillator cathode follower
V9	12AT7	Efficiency countdown multivibrator
V10	6AS6	Coincidence amplifier

TABLE 1-3. VACUUM TUBE COMPLEMENT (Cont)

ITEM NUMBER	TUBE TYPE	FUNCTION
V11	12AT7	Distance selector gate
V12	6AS6	Phantastron delay
V13A	1/2 12AU7	Calibration oscillator
V13B	1/2 12AU7	Trigger generator
V14	12AT7	Calibration prf
V15A	1/2 12AU7	Range pulse amplifier
V15B	1/2 12AU7	Calibration cathode follower
V16A	1/2 12AU7	Efficiency gate amplifier
V16B	1/2 12AU7	Range trigger generator
V17A	1/2 12AU7	Trigger generator
V17B	1/2 12AU7	Identification oscillator
V18A	1/2 5687	Squitter generator
V18B	1/2 5687	Suppressor pulse generator
V19A	1/2 12AU7	Range mixer amplifier
V19B	1/2 12AU7	Squitter mixer amplifier
V20A	1/2 12AU7	Not Used
V20B	1/2 12AU7	Encoder trigger generator
V21A	1/2 12AT7	Delayed encoder trigger generator
V21B	1/2 12AT7	Mixer amplifier
V22	12AT7	Pulse width multivibrator
V23	5687	Reply cathode follower
V24A	1/2 6080	250-volt series regulator
V24B	1/2 6080	150-volt series regulator
V25	6AU6	Regulator amplifier
V26	6AU6	Regulator amplifier
V27	OB2	Bias regulator

TABLE 1-4
DIODE COMPLEMENT

ITEM NUMBER	DIODE TYPE	FUNCTION
CR1	1N628	Gate
CR2	1N628	Gate
CR3	1N67	Damper
CR4	1N914	Gate
CR5	1N67	Damper
CR6	1N914	Gate
CR7	1N628	Clamper
CR8	1N67	Damper
CR9	1N628	Gate
CR10	1N67	Gate
CR11	1N628	Clamper
CR12	1N628	Damper
CR13	1N628	Gate
CR14	1N67	Clamper
CR15	1N67	Gate
CR16	1N67	Clamper
CR17	1N67	Clamper
CR18	1N67	Clamper
CR19	1N67	Damper
CR20	1N67	Gate
CR21	1N628	Clamper
CR22	1N628	Clamper
CR23	1N628	Clamper
CR24	1N628	Gate
CR25	1N67	Gate
CR26	1N628	Clamper
CR27	1N628	Gate
CR28	1N724A	Voltage regulator

TABLE 1-4
DIODE COMPLEMENT (Cont)

ITEM NUMBER	DIODE TYPE	FUNCTION
CR29	1N628	Gate
CR30	1N67	Gate
CR31	1N628	Clamper
CR32	1N67	Gate
CR33	1N628	Damper
CR34	1N628	Gate
CR35 thru CR42	1N1492	Rectifiers
CR43	1N67	Gate
CR44	1N628	Gate
CR45	1N628	Clamper
CR46	1N628	Clamper
CR47	1N67	Gate
CR48	1N67	Damper
CR49	1N67	Clamper
CR50	1N67	Clamper
CR51	1N67	Damper
CR53	1N758	Voltage regulator

TABLE 1-5
CRYSTAL COMPLEMENT

ITEM NUMBER	FREQUENCY	FUNCTION
Y1	89.9 kc	Gated oscillator calibration
Y2	98.48 kc	Zero delay calibration

TABLE 1-6
FUSE COMPLEMENT

ITEM NUMBER	RATING	FUNCTION
F1	2 amperes	115-, 220-, or 230-volt 60-cps power
F2	2 amperes	27.5-volt d-c power
F3	2 amperes	115-volt 400-cps power
F4	3/4 amperes	115-volt 400-cps power

NOTE

Fuse F1 is a 2-ampere fuse. When the 578D-1 is wired for 220- or 230-volt operation, a 1-ampere fuse should be used. All fuses are slo-blo type.

1.8 COOLING REQUIREMENTS.

When mounted in a standard 19-inch relay rack, the 578D-1 requires no cooling other than that provided by convection. Other equipment mounted in the rack should be separated from the 578D-1 by a minimum vertical distance of 1-3/4 inches (standard A panel) to provide adequate ventilation. If equipment mounted below the 578D-1 generates a large amount of heat, it may be necessary to provide a rack blower to keep the temperature of the 578D-1 below the maximum permissible ambient of 131°F (55°C) at all times. It is recommended that adequate ventilation be provided to keep the ambient temperature below 95°F (35°C) for high reliability and long life of the component parts of this unit.

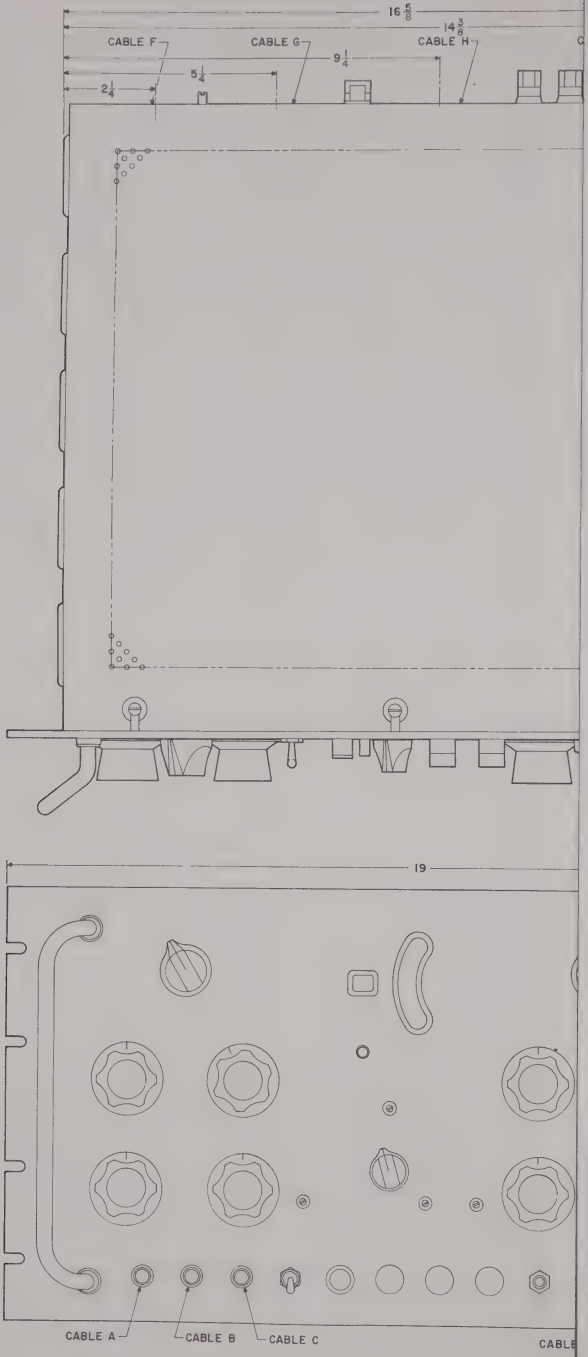


Figure 2-1. DME Bench Test Set 578D-1, Outline and Mounting Dimensions

SECTION II
INSTALLATION

2.1 MOUNTING.

DME Bench Test Set 578D-1 mounts in a 19-inch relay rack. See paragraph 1.8 for information on cooling requirements. See figure 2-1 for mounting information.

2.2 POWER CONSIDERATIONS.

The 578D-1 will operate from a 115-volt, 220-volt, or 230-volt source. The 578D-1 comes from the factory wired for 115-volt operation. To convert the 578D-1 to 220-volt or 230-volt operation, connect the jumpers on the primary winding of power transformer T9 as shown in figure 2-2. If the 578D-1 is rewired for 220-volt or 230-volt operation, change the flag on the rear of the unit to indicate 220-volt or 230-volt operation.

2.3 CONNECTIONS.

Cable assembly, Collins part number 426-5041-00, is used to connect the 578D-1 to the power source. Cable assembly, Collins part number 547-2028-004, is used to connect the 578D-1 to the DME under test.

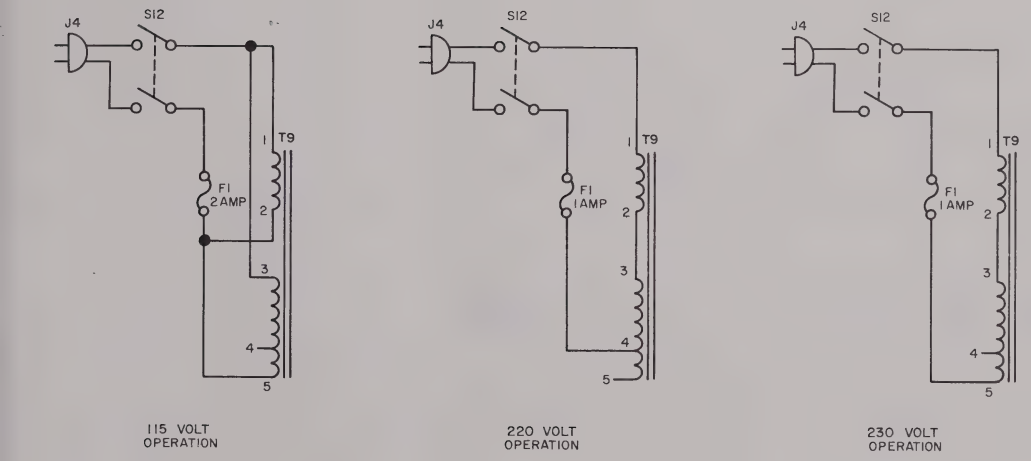
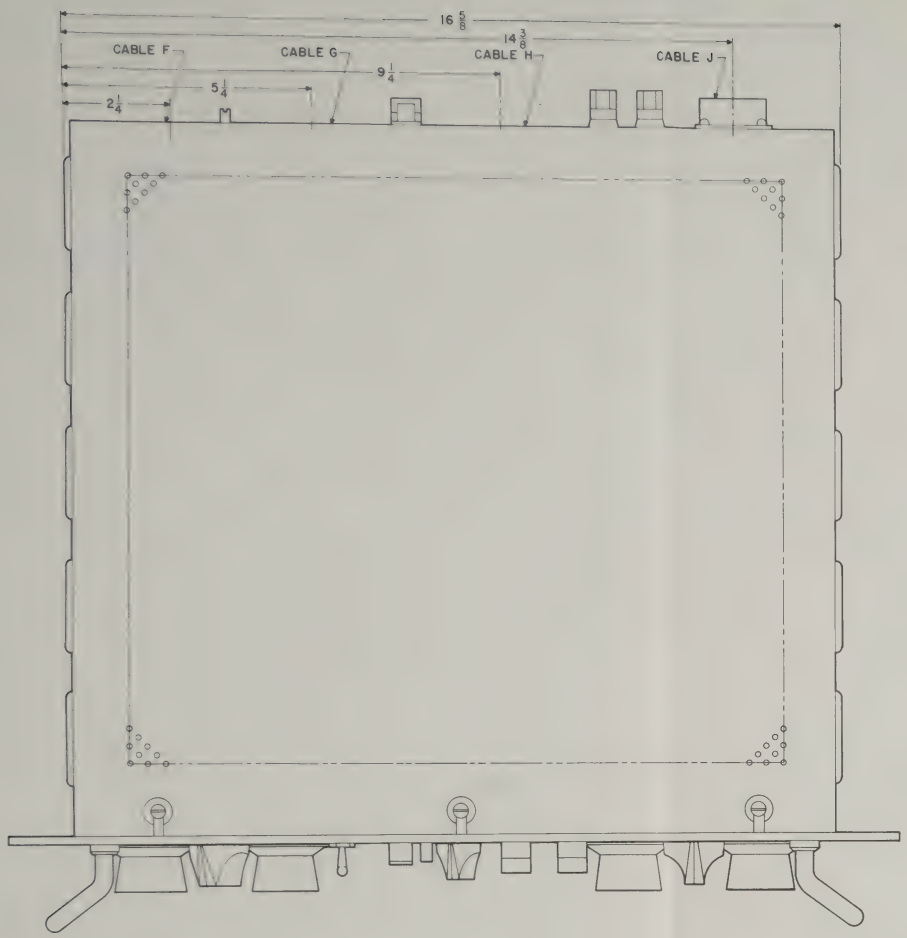
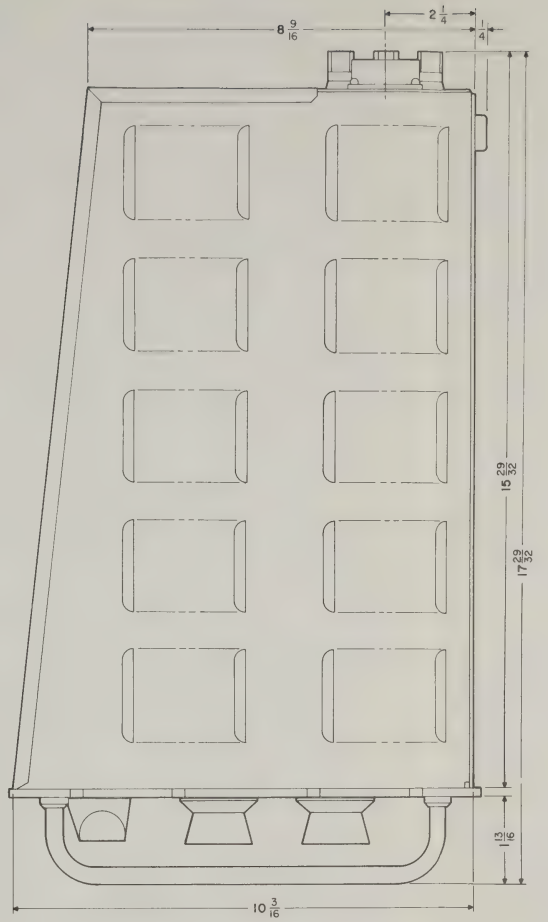
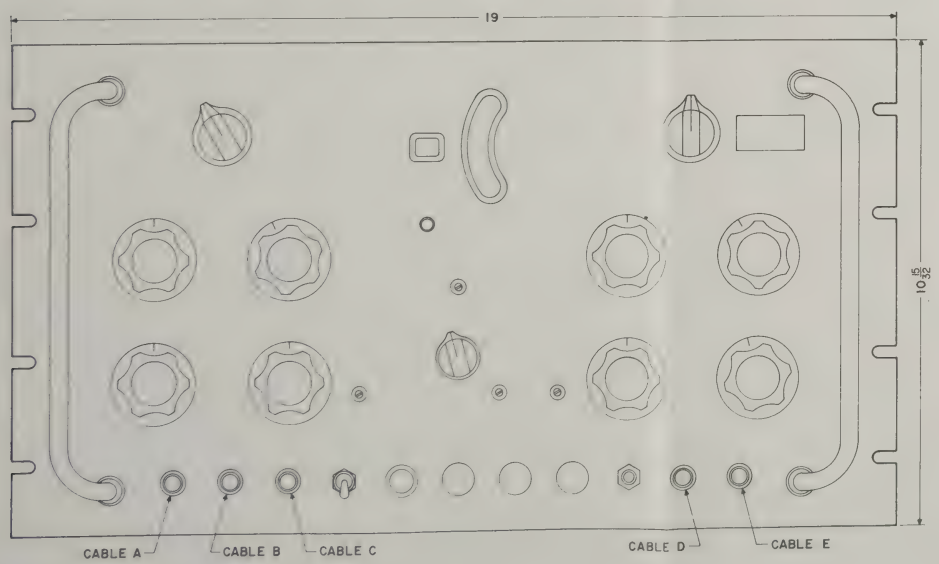


Figure 2-2. Power Transformer Connections







CABLES SUPPLIED WITH EQUIPMENT		
CABLE	578D-1 END	OPP END
A	COAX CONN	COAX CONN TO BOONTON EQUIP
B	COAX CONN	COAX CONN TO BOONTON EQUIP
C	COAX CONN	COAX CONN TO DME
D	COAX CONN	COAX CONN TO OSCILLOSCOPE
E	COAX CONN	COAX CONN TO OSCILLOSCOPE
F	2 PIN POWER CONN 28V DC	NONE
G	3 PIN POWER CONN 115V AC 400CPS	NONE
H	3 PIN POWER CONN 115V AC 400CPS	3 PIN PWR CONN 115V AC 60 CPS WITH ADAPTER
J	50 PIN CONN	(2) 32 PIN CONN TO DME

Figure 2-1. DME Bench Test Set 578D-1, Outline and Mounting Dimensions

SECTION II
INSTALLATION

2.1 MOUNTING.

DME Bench Test Set 578D-1 mounts in a 19-inch relay rack. See paragraph 1.8 for information on cooling requirements. See figure 2-1 for mounting information.

2.2 POWER CONSIDERATIONS.

The 578D-1 will operate from a 115-volt, 220-volt, or 230-volt source. The 578D-1 comes from the factory wired for 115-volt operation. To convert the 578D-1 to 220-volt or 230-volt operation, connect the jumpers on the primary winding of power transformer T9 as shown in figure 2-2. If the 578D-1 is rewired for 220-volt or 230-volt operation, change the flag on the rear of the unit to indicate 220-volt or 230-volt operation.

2.3 CONNECTIONS.

Cable assembly, Collins part number 426-5041-00, is used to connect the 578D-1 to the power source. Cable assembly, Collins part number 547-2028-004, is used to connect the 578D-1 to the DME under test.

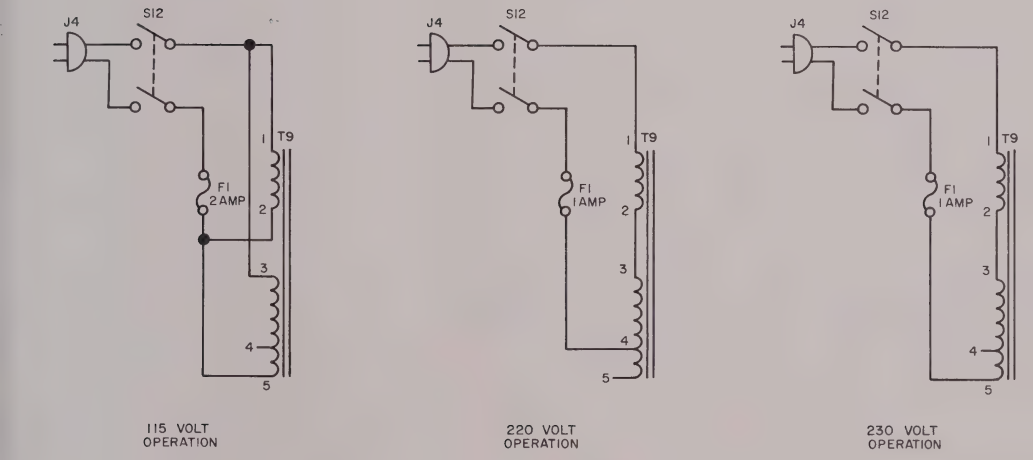


Figure 2-2. Power Transformer Connections

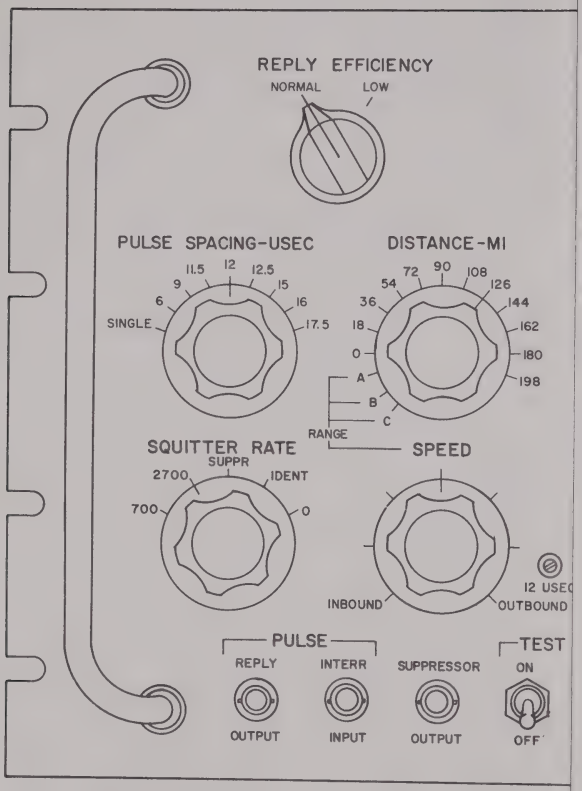


Figure 3-1. Operating Controls

SECTION III
OPERATION

3.1 GENERAL.

This section describes the procedures to be used in testing a DME with the 578D-1 in conjunction with the Boonton 235-A. Refer to the specific manual for overhaul procedures for the DME equipment. The overhaul manual for Collins DME, Radio Set 860E-1 is Collins part number 523-0050-003.

3.2 OPERATING CONTROLS.

Table 3-1 lists all the controls that are used in normal operation of the 578D-1. All controls which are not listed in table 3-1 are used in calibration of the 578D-1.

TABLE 3-1. OPERATING CONTROLS

CONTROL	SYMBOL	FUNCTION
REPLY EFFICIENCY	S1	Selects the ratio of reply pulses to interrogation pulses.
SYNC SELECTOR	S2	Selects one of three signals for synchronization of an oscilloscope.
PULSE SPACING-USEC	S3	Selects spacing of reply pulse-pairs.
DISTANCE-MI	S4	Selects one of twelve fixed distances or one of three variable ranges. The three ranges are approximately 1-70 (A), 70-140 (B), and 140-210 (C).
SPEED	R119	Controls the speed and direction within the variable range selected by S4.
SQUITTER RATE	S5	Controls squitter rate, identification, and suppressor output.
Calibration Selector	S7	Always leave in OPERATE position.
OFF-STBY-ON	S8	Controls primary power to DME under test.
SEARCH LIMIT	S9	Override limited search range of DME on certain channels.
CHANNEL	S10, S11	Set DME to operating channel.
TEST SET ON-OFF	S12	Controls primary power to 578D-1.

Each of the controls listed in 3-1 is shown in figure 3-1.

3.3 DME TESTING.

3.3.1 GENERAL.

The following paragraphs outline the tests which may be made on a DME using the 578D-1 and the 235-A. Specific overhaul procedures or test limits are not given.

3.3.2 TEST SETUP.

a. Interconnect the DME and the test equipment as shown in figure 3-2.
b. Set all operating controls as specified in table 3-2.

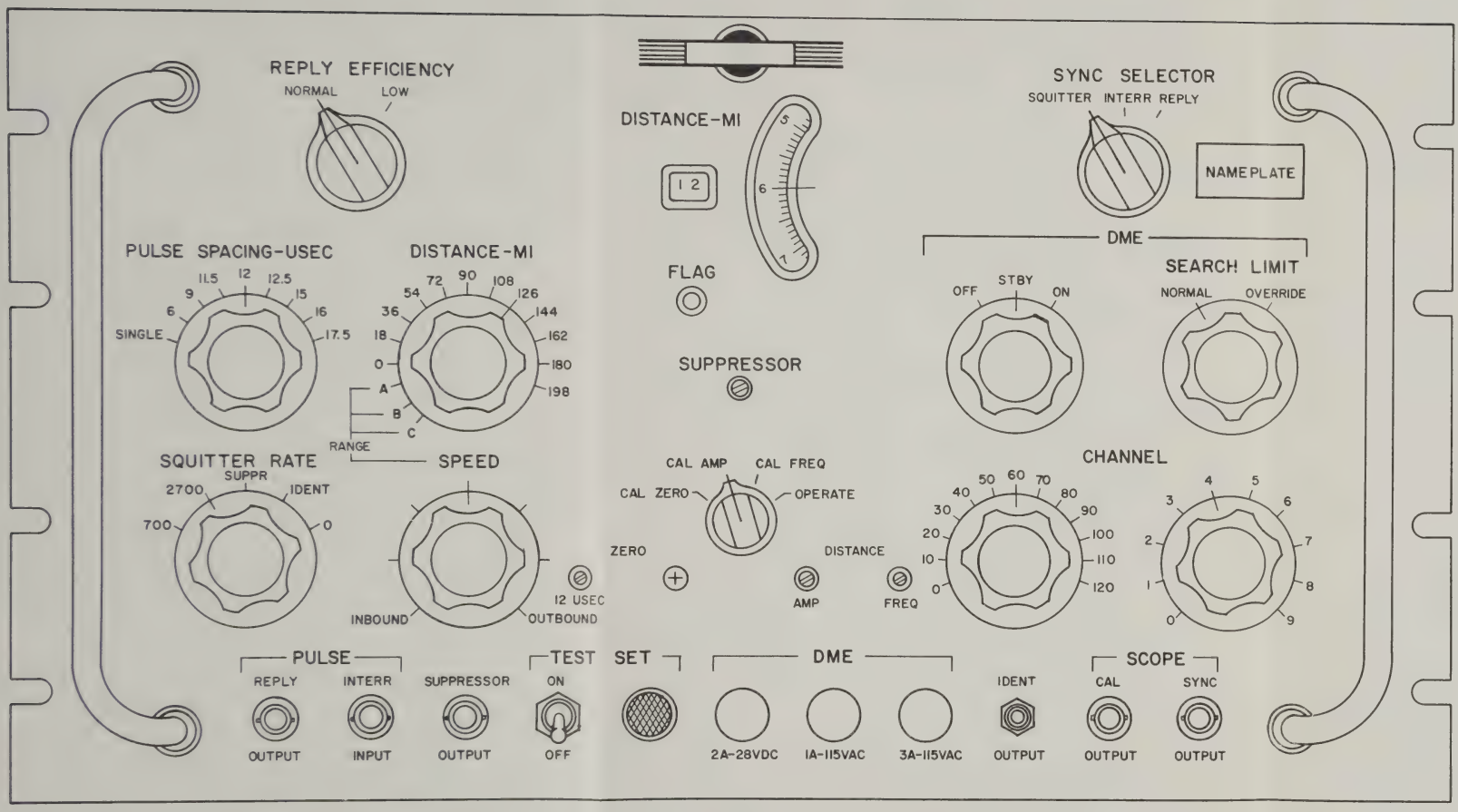


Figure 3-1. Operating Controls

SECTION III
OPERATION

3.1 GENERAL.

This section describes the procedures to be used in testing a DME with the 578D-1 in conjunction with the Boonton 235-A. Refer to the specific manual for overhaul procedures for the DME equipment. The overhaul manual for Collins DME, Radio Set 860E-1 is Collins part number 523-0050-003.

3.2 OPERATING CONTROLS.

Table 3-1 lists all the controls that are used in normal operation of the 578D-1. All controls which are not listed in table 3-1 are used in calibration of the 578D-1.

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Calibration Selector	S7	Always leave in OPERATE position.
OFF-STBY-ON	S8	Controls primary power to DME under test.
SEARCH LIMIT	S9	Override limited search range of DME on certain channels.
CHANNEL	S10, S11	Set DME to operating channel.
TEST SET ON-OFF	S12	Controls primary power to 578D-1.

Each of the controls listed in table 3-1 is shown in figure 3-1.

3.3 DME TESTING.

3.3.1 GENERAL.

The following paragraphs outline the tests which may be made on a DME using the 578D-1 and the 235-A. Specific overhaul procedures or test limits are not given.

3.3.2 TEST SETUP.

a. Interconnect the DME and the test equipment as shown in figure 3-2.
b. Set all operating controls as specified in table 3-2.

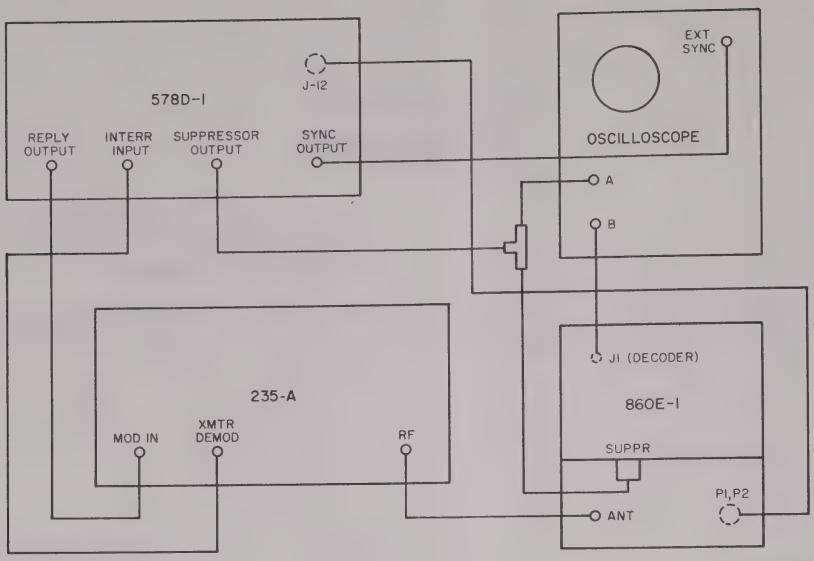

Figure 3-2. Test Setup

TABLE 3-2. INITIAL SETTING OF OPERATING CONTROLS

CONTROL	SETTING	CONTROL	SETTING
578D-1		578D-1 (Cont)	
REPLY EFFICIENCY	NORMAL	SEARCH LIMIT	NORMAL
PULSE SPACING-USEC	12	CHANNEL	126
DISTANCE-MI	72	TEST SET ON-OFF	ON
SQUITTER RATE	2700	235-A	
SPEED	Center	Channel	126
SYNC SELECTOR	INTERR	NORMAL/PWR MEAS	NORMAL
OFF-STBY-ON	STBY	960-1049 mc/1130-1219 mc	1130-1219 mc
		Power	ON
		Attenuator	-20 dbm

c. Apply power to the 578D-1, the 235-A, and the DME under test.

3.3.3 CALIBRATION OF 235-A.

a. Set the function selector on the 235-A to the CW position.

b. Turn the RF control on the 235-A to the maximum counterclockwise position.

c. Adjust the ZERO control on the 235-A until the front panel meter on the 235-A indicates 0.

d. Adjust the RF control on the 235-A until the front panel meter pointer is aligned with the red line on the meter scale.

e. Set the function selector on the 235-A to the CAL position, and note the meter indication.

f. Set the function selector on the 235-A to the PULSE position, and adjust the MOD LEVEL control on the 235-A for the same meter reading observed in step e.

NOTE

The MOD LEVEL control should be adjusted to the point at which the reading is first observed. Always approach this point by turning the control in a clockwise direction. Additional turning of the MOD LEVEL control may provide the same indication as in step e but will cause the final doubler to draw grid current.

3.3.4 TRANSMITTER POWER OUTPUT.

a. Set the function selector on the 235-A to the PWR MEAS position.

b. See that the CHANNEL selectors on both the 578D-1 and the 235-A are set to the same channel.

c. Record the indication of the front panel meter on the 235-A.

d. Set the NORMAL-PWR MEAS switch to PWR MEAS.

e. Adjust the attenuator control on the 235-A to obtain the same meter reading recorded in step c.

f. Read the transmitter power output on the DBW IN dial. It should be within the limits specified by the DME equipment handbook.

3.3.5 TRANSMITTER PULSE CHARACTERISTICS.

a. Connect the XMTR DEMOD output on the 235-A to the vertical input on the oscilloscope.

b. Connect the SUPPR output on the DME equipment to the EXT SYNC connector on the oscilloscope.

c. Observe the pulse characteristics on the oscilloscope. Check the pulse rise time, decay time, pulse duration, pulse spacing, and any other characteristics specified in the DME equipment handbook.

3.3.6 RECEIVER SENSITIVITY.

a. Connect equipment as shown in figure 3-2.

b. Set the CHANNEL selectors on the 578D-1 and 235-A to channel 1. The receiver frequencies for the TACAN channels are given in table 3-3.

c. Repeat the procedures in paragraph 3.3.3.

d. Set the attenuator control on the 235-A to the reading required for maximum sensitivity as specified by the DME equipment handbook.

e. Switch the DISTANCE-MI selector on the 578D-1 to the 18 position. When the DME has switched to the search mode (distance indicator moves away from 0), return the DISTANCE-MI selector to the 0 position. The DME should again track at 0. Refer to the DME equipment handbook for maximum sensitivity specifications.

3.3.7 AGC OPERATION.

a. Perform steps a through c of paragraph 3.3.6.

b. Connect a vtvm to the agc test jack on the DME equipment under test.

c. Vary the setting of the attenuator control on the 235-A as specified in the DME equipment handbook. The variation in agc voltage should be within the limits specified in the DME equipment handbook.

3.3.8 DECODER SELECTIVITY.

a. Select any channel on the 578D-1 and on the 235-A.

b. Set the attenuator control on the 235-A as specified in the DME equipment handbook for the decoder selectivity check.

c. Set the NORMAL-PWR MEAS switch on the 235-A to NORMAL and the function selector to PULSE on the 235-A.

d. Set the DISTANCE-MI selector on the 578D-1 to the 0 position.

e. When the DME has locked on zero mile, switch the PULSE SPACING-USEC control on the 578D-1 to each of the positions. The DME equipment should remain locked on zero mile or go into search mode after time intervals as specified in the DME equipment handbook.

3.3.9 IDENTIFICATION CHECK.

a. Select any channel on the 578D-1 and on the 235-A.

b. Set the attenuator control on the 235-A as specified in the DME equipment handbook for the identification check.

c. Insert a headphones plug into the IDENT OUTPUT jack on the 578D-1.

d. Key the identification tone by switching the SQUITTER RATE switch between the IDENT and 0 positions. The keyed tone should be heard in the headphones.

3.3.10 DISTANCE ACCURACY.

a. Select any channel on the 578D-1 and on the 235-A.

b. Set the PULSE SPACING-USEC switch to 12 on the 578D-1.

c. Set the SQUITTER RATE switch to 2700 on the 578D-1.

d. Set the DISTANCE-MI selector to 0, and allow the DME to lock on. Record the distance indicated by the DISTANCE-MI indicator on the 578D-1. The indication should be within the limits specified in the DME equipment handbook.

e. Repeat step d for each 18-mile increment through 198 miles. Refer to the DME equipment handbook for error limits.

3.3.11 TRACKING SENSITIVITY.

a. Set the DISTANCE-MI selector to RANGE A on the 578D-1.

b. Set the SPEED control on the 578D-1 to the second mark counterclockwise from center (IN BOUND).

c. Adjust the attenuator control on the 235-A until the DME equipment stops searching. The attenuator reading should be as specified in the DME equipment manual.

d. Repeat step c with the SPEED control on the 578D-1 set to the second mark clockwise (OUT BOUND).

TABLE 3-3. OPERATING FREQUENCIES FOR TACAN CHANNELS

TACAN CHANNEL NUMBER	DME G to A (mc)	DME A to G (mc)
1	962	1025
2	963	1026
3	964	1027
4	965	1028
5	966	1029
6	967	1030
7	968	1031
8	969	1032
9	970	1033
10	971	1034
11	972	1035
12	973	1036
13	974	1037
14	975	1038
15	976	1039
16	977	1040
17	978	1041
18	979	1042
19	980	1043
20	981	1044
21	982	1045
22	983	1046
23	984	1047
24	985	1048
25	986	1049
26	987	1050
27	988	1051
28	989	1052
29	990	1053
30	991	1054
31	992	1055
32	993	1056
33	994	1057
34	995	1058
35	996	1059
36	997	1060
37	998	1061
38	999	1062
39	1000	1063
40	1001	1064
41	1002	1065
42	1003	1066
43	1004	1067
44	1005	1068
45	1006	1069
46	1007	1070
47	1008	1071
48	1009	1072
49	1010	1073
50	1011	1074
51	1012	1075
52	1013	1076
53	1014	1077
54	1015	1078
55	1016	1079
56	1017	1080
57	1018	1081
58	1019	1082
59	1020	1083
60	1021	1084
61	1022	1085
62	1023	1086

TABLE 3-3. OPERATING FREQUENCIES FOR TACAN CHANNELS (Cont)

TACAN CHANNEL NUMBER	DME G to A (mc)	DME A to G (mc)
63	1024	1087
64	1151	1088
65	1152	1089
66	1153	1090
67	1154	1091
68	1155	1092
69	1156	1093
70	1157	1094
71	1158	1095
72	1159	1096
73	1160	1097
74	1161	1098
75	1162	1099
76	1163	1100
77	1164	1101
78	1165	1102
79	1166	1103
80	1167	1104
81	1168	1105
82	1169	1106
83	1170	1107
84	1171	1108
85	1172	1109
86	1173	1110
87	1174	1111
88	1175	1112
89	1176	1113
90	1177	1114
91	1178	1115
92	1179	1116
93	1180	1117
94	1181	1118

TACAN CHANNEL NUMBER	DME G to A (mc)	DME A to G (mc)
95	1182	1119
96	1183	1120
97	1184	1121
98	1185	1122
99	1186	1123
100	1187	1124
101	1188	1125
102	1189	1126
103	1190	1127
104	1191	1128
105	1192	1129
106	1193	1130
107	1194	1131
108	1195	1132
109	1196	1133
110	1197	1134
111	1198	1135
112	1199	1136
113	1200	1137
114	1201	1138
115	1202	1139
116	1203	1140
117	1204	1141
118	1205	1142
119	1206	1143
120	1207	1144
121	1208	1145
122	1209	1146
123	1210	1147
124	1211	1148
125	1212	1149
126	1213	1150

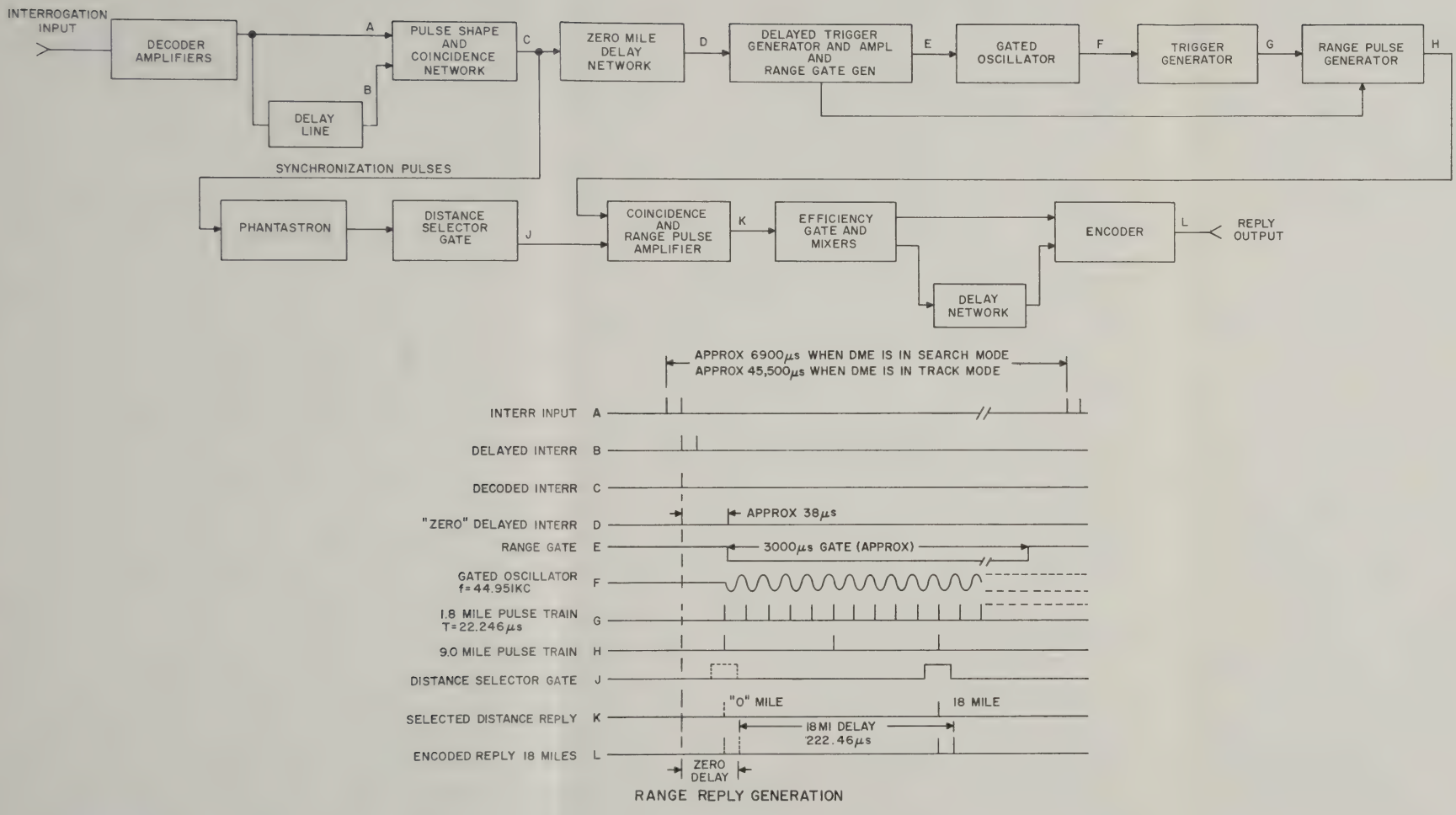

Figure 4-1. DME Bench Test Set 578D-1, Simplified Block Diagram

SECTION IV
PRINCIPLES OF OPERATION

4.1 GENERAL.

This section contains a description of the DME Bench Test Set 578D-1. A general description of the operation of the 578D-1 is given in paragraph 4.2. Detailed circuit operation is given in paragraph 4.3.

4.2 GENERAL PRINCIPLES OF OPERATION.

4.2.1 GENERAL.

The 578D-1 is used with the Boonton 235-A Navigation Aids Test Set for complete bench testing and alignment of distance measuring equipment (DME) which is in accord with ARINC Characteristic 521B dated August 12, 1957. Collins DME, Radio Set 860E-1, is such an equipment.

The 235-A demodulates the interrogation pulses from the DME and couples these pulses to the 578D-1. The 578D-1 then generates reply pulses which are coupled back to the 235-A. The 235-A modulates a uhf carrier with these reply pulses and returns this signal to the DME. Thus, the 578D-1 and 235-A simulate a DME ground station.

Controls are included on the 578D-1 and 235-A to control the operation of the DME and permit complete adjustment and test of the DME.

This section explains the operation of the 578D-1. For information of the 235-A, refer to the instruction book for that equipment.

4.2.2 SIMPLIFIED BLOCK DIAGRAM.

Refer to figure 4-1. The letters in brackets refer to the signals shown in the lower portion of figure 4-1.

The demodulated interrogation input from the 235-A is connected to two decoder amplifiers. The amplified interrogation pulses are then coupled to two places. One output (A) is coupled to the pulse shaping and coincidence network. The other output (B) is connected through a 12-microsecond delay line to the pulse shaping and coincidence network. A proper DME interrogation signal is two pulses spaced 12-microseconds apart. The output of the coincidence network exists only when the interrogation input consists of pulse-pairs spaced 12 microseconds apart.

The decoded interrogation (C) is coupled to another delay network, the zero mile delay network. This delay, which is adjustable, is required to adjust the minimum amount of time it takes for the 578D-1 to reply to an interrogation. In the actual DME system, it takes a certain amount of time for the ground station to reply to an interrogation. The ground stations delay their reply so that each ground station may be adjusted to exactly the same standard delay. The zero mile delay network is adjusted so that the total delay through the 578D-1 and 235-A (when responding with a reply pulse indicating zero mile) is 50.77 microseconds.

The "zero" delayed interrogation pulse (D) is coupled to a network containing a trigger generator, a trigger amplifier, and a gate generator. The output of this network is a range gate (E) which begins at the time of the "zero" delayed pulse and continues for approximately 3000 microseconds. The maximum rate of interrogation by a DME is approximately once every 7000 microseconds. The gate ensures that the gated oscillator is turned on at the right time. The range gate (E) is coupled to an oscillator. This oscillator operates at a frequency of 44.951 kilocycles, and has an output only during the time that the range gate (E) is applied. The output of the gated oscillator (F) is applied to a trigger generator which generates a train of pulses (G) at the same frequency. The time between consecutive positive pulses is 22.246 microseconds. This represents the time required for an electromagnetic wave to travel 3.6 miles (1.8 miles each way) in space.

The 22.246-microsecond pulse train (G) is coupled to a range pulse generator which produces a pulse at its output for every fifth pulse of the 22.246-microsecond pulse train. The output of the range pulse generator (H) is a series of pulses spaced 111.23 microseconds apart which is the time required for an electromagnetic wave to travel 18.0 miles (9.0 miles each way) in space. The 111.23-microsecond pulse train is coupled to a coincidence gate and range pulse amplifiers.

The other input to the coincidence gate is the distance selector gate (J). The distance selector gate is generated by coupling the decoded interrogation signal (C) to a phantastron which delays the pulse in accordance with the distance selected on the front panel of the 578D-1. The selected distance illustrated in figure 4-1 is 18 miles. The output of the phantastron is coupled to a distance selector gate which is a monostable multivibrator. The output of the distance selector gate (J) is coupled to the same coincidence network to which the 111.23-microsecond pulse train (H) is coupled. The output of the coincidence gate is the pulse from the 111.23-microsecond pulse train which occurs at the same time as the distance selector gate (J). There will be an output pulse here for every interrogation received. These pulses are coupled to

an efficiency gate which randomly removes 30 or 50 percent of the reply pulses to simulate normal and low operating conditions.

Additional signals are mixed with the range pulse, and the composite signal is fed (1) directly to an encoder and (2) through a delay network to the encoder. The delay network produces a pulse 12 microseconds later than the undelayed pulse. The output signal, like the input signal, consists of pulse-pairs spaced 12 microseconds apart. The encoder adjusts the pulses to the proper width and then couples them to a cathode follower output stage. The encoded reply is the signal that will appear at the output when the selected distance is 18 miles.

4.3 DETAILED PRINCIPLES OF OPERATION.

4.3.1 GENERAL.

The following paragraphs describe in detail the operation of the circuits within the 578D-1. Refer to the detailed block diagram, figure 4-2, and the complete schematic diagram, figure 7-1.

4.3.2 DECODING CIRCUITS.

The interrogation input signal (positive pulse-pairs spaced 12 microseconds apart) is connected to the cathode of V1A, a grounded-grid amplifier. V1A provides a low-impedance input to the 578D-1. The input signal is amplified in V1A and coupled to V1B, a conventional amplifier, for further amplification. The output of V1B is coupled to (1) a 12-microsecond delay line and (2) a pulse shaper, V2A. The delay line delays the pulses 12 microseconds then couples them to another pulse shaper, V2B.

The outputs from the two pulse shapers, V2A and V2B, are coupled to an AND coincidence network. The coincidence network has an output when and only when pulses are simultaneously applied to CR4 and CR6. If the input interrogation signal was a pulse-pair spaced 12 microseconds apart (a standard DME interrogation signal), the second pulse of this signal will be in coincidence with the first pulse of the delayed signal, and a single pulse will be coupled to V3A, a trigger amplifier. The output of V3A, a negative pulse, is coupled to the plate of V3B, a blocking oscillator. This pulse is transformed to a positive pulse in T1 and coupled to the grid of V3B. The resultant output at the cathode of V3B is a very sharp positive pulse. This pulse is coupled to the zero mile delay network, and a small amount is coupled to the SYNC SELECTOR for synchronization of an oscilloscope. A negative pulse appears across the output winding of T1. This pulse is coupled to the phantastron.

4.3.3 PULSE TRAIN GENERATION.

The decoded pulse is coupled to a delay network which is adjusted so that the total delay through the 578D-1 and 235-A is 50.77 microseconds. This delay is in addition to any delay set into the 578D-1 to simulate distance. The delayed pulse is coupled to the grid of V4A which develops a positive pulse at its plate. This positive pulse is amplified in V4B and coupled to the range gate generator, V5. V5 is a monostable multivibrator with a time constant of approximately 3000 microseconds. V5 remains in the quiescent condition (V5A conducting and V5B cut off) until the negative pulse from V4B appears at the plate of V5A. This pulse cuts off V5A and causes V5B to conduct. The charge on C31 discharges through R41 placing a negative voltage on the grid of V5A, keeping V5A biased off. When C31 has discharged sufficiently to allow V5A to conduct, V5B again becomes cut off, and the quiescent condition is restored. The amount of time required for V5A to return to the quiescent condition after being triggered is determined by the values of C31 and R41. The values shown in figure 7-1 cause this time to be approximately 3000 microseconds. The resultant signal, which is coupled to the grid of V6A, is a negative pulse which starts with the delayed trigger and ends approximately 3000 microseconds later. The negative pulse turns oscillator gate V6A off allowing V6B to oscillate. The gated oscillator produces a 44.951-kilocycle signal.

The output of V6B is coupled to a trigger generator, V7. The input circuit to V7 clips the positive cycles of the 44.951-kc signal. Transformer T2 couples positive pulses to the cathode of V7 at the same time that negative pulses are being applied to the grid of V7. The output of V7 is a train of sharp positive pulses spaced 22.246 microseconds apart.

This pulse train is coupled to the range pulse generator V8A, which generates a pulse output for every fifth pulse of the pulse train. The output of V8A is a train of pulses spaced 111.23 microseconds apart. A portion of the signal from the cathode of V5B is coupled to the grid of V8A to stabilize the grid voltage during counting.

The adjustments in the pulse train generation circuits include a coarse zero adjustment, S6, and a fine zero adjustment, C16. These are used to adjust the standard delay through the 578D-1 and 235-A. The frequency adjustment, C32, adjusts the frequency of the gated oscillator. The amplitude adjustment, R46, adjusts the amplitude of the gated oscillator output. The countdown adjustment, R64, adjusts the range pulse generator so that it counts exactly five pulses of the input pulse train before it produces an output pulse.

4.3.4 DISTANCE SELECTION CIRCUITS.

The DISTANCE-MI switch, S4, is used to select the amount of distance to be simulated between the DME and the 578D-1. One of the twelve fixed distances (0 through 198 miles in 18-mile increments) may be selected with S4. The rear side of switch section S4A selects the appropriate bias voltage for the phantastron, V12. This bias determines the pulse width of the phantastron output pulse which, in turn, determines the amount the reply pulse will be delayed.

The decoded interrogation pulse is coupled to the plate of V12 and starts the output pulse. The width of the pulse is determined by the setting of S4. At the end of this pulse, a negative pulse is coupled from the screen grid of V12 throgh C54 and CR20 to the plate of V11A and through C53 to the grid of V11B. V11A and V11B form a monostable multivibrator with a time constant of approximately 100 microseconds. When the negative pulse from V12 reaches the grid of V11B, it cuts V11B off, which causes V11A to conduct. This condition will continue until C53 discharges to below the cutoff bias for V11B, allowing V11B to conduct which causes V11A to be biased off. The output pulse of V11B is a positive pulse approximately 100 microseconds wide. This pulse is coupled to the control grid of coincidence amplifier V10.

The output of V8A (see paragraph 4.3.3) is a train of pulses spaced 111.23 microseconds apart. The selectable distances are in 18-mile increments, but the pulse train from V8A corresponds to 9-mile increments. Therefore, there are twice as many pulses as are required from V8A. These pulses are coupled to the suppressor grid of coincidence amplifier V10. When the gate from V11B and a pulse from V8A are simultaneously applied to V10, V10 turns on, and the pulse from V8A appears on the plate of V10. When either input is missing, there is no output from V10.

In addition to the twelve specific ranges which may be selected on S4, there are three RANGE positions. These positions are used when it is desired to have the DME track a constantly changing range. In fact, this is what the DME does when installed and operating in an aircraft. The following paragraph explains the operation of the distance selection circuits when DISTANCE-MI selector S4 is in one of the range positions.

The three positions, A, B, and C, provide three ranges of operation. When S4 is in one of these positions, the switch contacts perform the following functions. Switch wafer S4B disconnects +250 volts d-c from the plate of V8A to discontinue the 9.0-mile pulse train, and also connects +27.5 volts d-c to R119 and R120. These potentiometers are connected to the SPEED control on the front panel of the 578D-1 and control the speed and direction of rotation of range motor B4. Range motor B4 rotates potentiometer R118 which then applies a continuously and smoothly varying bias voltage to the phantastron, V10. Switch wafer S4A connects the appropriate resistor in series with R118 to adjust the range over which the phantastron bias will be varied. Switch wafer S4A also connects R118 to the phantastron. Switch wafer S4C disconnects the normal output circuit from the distance selector gate and inserts an r-c differentiator to make the output a sharp pulse. These sharp pulses are connected to the control grid of V10. Finally, switch section S4D connects sufficient bias to the suppressor grid of V10 to allow the pulses on the control grid to control conduction of V10. Thus, when S4 is in one of the three range positions, a constantly varying range reply pulse will be returned for each interrogation. There are only two adjustments in the distance selection circuits. One is the SLOPE ADJUST control, C133, and the other is the 18-MI ADJ control, R101. These controls are used to adjust the timing of the distance selector gate.

4.3.5 MIXING AND ENCODING CIRCUITS.

The output of coincidence amplifier V10 is coupled to a range pulse amplifier, V15A. The amplified pulse is coupled to efficiency gate amplifier V16A. The output of the efficiency countdown multivibrator, V9, is also coupled to V16A. The efficiency countdown multivibrator is synchronized to line frequency. Two frequencies may be selected from the front panel by means of S2, the REPLY EFFICIENCY switch. When S2 is in the NORMAL position, approximately 70 percent of the pulses from V15A are coupled through V16A. When S2 is in the LOW position, approximately 50 percent of the pulses are coupled through V16A. The plate voltage to V9 is controlled by S5B and removes the plate voltage when S5 is in the 0 or SUPPR positions. This allows all pulses to be coupled through V16A.

The output of V16A is coupled to a blocking oscillator trigger generator, V16B. V16B sharpens the range pulses and couples them to the range mixer amplifier, V19A. The output of V19A is coupled to the encoder trigger generator, V20B. The output of V19B, squitter mixer amplifier, is also connected to V20B. Squitter is the name given to the pulses which are used to fill in between the reply pulses. The squitter pulses are generated by V18A, a blocking oscillator. The blocking oscillator is free running with a small amount of synchronization from the 6.3-volt a-c line. The frequency may be set to 700, 2700 or IDENT by the SQUITTER RATE switch, S5. The 700 and 2700 rates are set by adjusting R168 and R165 respectively. The squitter rate in the IDENT mode must be exact and is controlled by triggers from V17A. The identification oscillator is a phase-shift oscillator, and its frequency is adjusted to exactly 1350 cps by R156. The output of V17B is connected to V17A which generates triggers for the squitter generator, V18A. Switch S5 disables V16B when in the IDENT mode preventing distance replies. The output of V18A is connected to the squitter mixer amplifier, V19B, which amplifies these pulses and couples them to V20B, the encoder trigger generator. The suppressor pulse generator is also controlled by S5. When S5 is in the SUPPR position, the suppressor pulse generator produces a pulse output when triggered by the range pulse from the plate of V16B.

There are two outputs from the encoder trigger generator, V20B. Both outputs are taken from the cathode. One output is coupled directly to the control grid of mixer amplifier V21B through diode CR43. The other output is coupled to the pulse spacing delay network. This network is adjustable from the front panel through the use of PULSE SPACING-USEC switch, S3. The

network delays the input pulse in accordance with the setting of S3. Trimmer capacitors are used to adjust the amount of delay at each position of S3. The output of the delay network is coupled to the delayed encoder trigger generator V21A, to sharpen up the pulse. The output of V21A is connected to the control grid of V21B where it is mixed with the undelayed pulses. The output of V21B is connected to the pulse width multivibrator, V22, which adjusts the pulse width of each pulse to 3.5 microseconds. The amount of pulse width that V22 will give to each pulse is controlled by C116. V22 is a monostable multivibrator which stays in the unstable state for 3.5 microseconds. The output of V22 is connected to the reply cathode follower, V23. The output of V23 is connected to J2 through R205, the REPLY CONTROL adjustment.

4.3.6 CHANNEL SELECTOR AND DISTANCE INDICATORS.

The 578D-1 contains the controls necessary to set the DME to any of the designated DME channels. Switches S10 and S11 are identified on the front panel as CHANNEL SELECTOR. The DME equipment determines the distance represented by the reply pulses returned by the 578D-1 and converts this information into synchro information. Three synchros in the 578D-1 are connected to the DME to read out the distance on the front panel of the 578D-1. The front panel also contains a flag alarm indicator designated FLAG and a phone jack identified IDENT OUTPUT for monitoring the identification signal as detected by the DME.

4.3.7 CALIBRATION CIRCUITS.

There are two circuits within the 578D-1 which must be calibrated periodically to ensure proper operation of the 578D-1. The signals required to calibrate these circuits are contained in the 578D-1 to minimize the amount of test equipment required to adjust the 578D-1. The two circuits which require calibration are the zero delay network and the gated oscillator.

The calibration selector switch, S7, switches the various circuit connections to accomplish these calibrations. V13A is the calibration oscillator and is crystal controlled at one of two frequencies depending on the circuit being calibrated. One frequency, 89.9 kc, is used to calibrate the gated oscillator, V6, and the other, 98.48 kc, is used to calibrate the zero delay network.

The gated oscillator is calibrated by comparing the frequency of the 89.9-kc calibration signal with that of the gated oscillator on an oscilloscope. The Lissajous pattern is a two-to-one (figure eight) pattern. Switch S7 connects the gated oscillator signal to the CAL OUTPUT jack on the front panel of the 578D-1 and connects the calibration oscillator signal to the SCOPE SYNC OUTPUT jack on the front panel of the 578D-1. A negative bias is applied to the grid of V6A through contacts of S7 to allow the oscillator V6B to run continuously during calibration. The CAL AMP position of S7 is used to adjust the gated oscillator for constant amplitude output.

The zero mile delay network is calibrated with the second crystal oscillator frequency, 98.48 kilocycles. The period of this signal is one-fifth of the zero mile delay. The calibration must correct for any delay caused in the 235-A and in the 578D-1. Refer to figure 4-3, a block diagram of the test setup required to make this adjustment.

The calibration oscillator, V13A, synchronizes blocking oscillator trigger generator, V13B. V13B divides the output of V13A by 5. The output of V13B is connected to an oscilloscope for calibration and also to the calibration prf generator. The prf generator simulates the prf of a DME in the search condition. The output from the prf generator is encoded to pulse-pairs spaced 12.0 microseconds apart, and this signal modulates the 235-A. The detected pulses from the 235-A are then coupled to the input of the 578D-1 and are processed in the same manner as normal DME interrogations. The zero mile pulse is selected at the coincidence amplifier, V10, and is applied to the second vertical input and to the external sync input on the oscilloscope. The zero mile delay network is then adjusted so that the 50-percent points of the leading edges of (1) the second pulse of the zero mile pulse generator and (2) the zero mile pulse from the coincidence amplifier coincide. Thus, the delay of the system is set to the spacing of the crystal-controlled zero mile pulse generator.

4.3.8 POWER SUPPLY CIRCUITS.

The supply voltage requirements for pulse amplifiers demand good regulation. The three d-c supplies for the 578D-1 are all regulated to very close limits. The -105-volt d-c supply is regulated with a conventional gas-filled regulator tube. The two positive supplies utilize series triode regulators. Operation of the two regulators is identical so only the +250-volt regulator will be described.

The series regulator V24B can be visualized as a variable resistance with its resistance varying as the voltage on its control grid varies. When the +250 volts at J13 decreases, the error amplifier, V25, decreases conduction because its control grid becomes less positive. This causes the plate voltage to increase which makes the control grid of V24A more positive. This causes V24A to conduct more heavily which decreases the voltage drop across it, thereby supplying more voltage to J13.

The input power transformer may be wired for either 115-, 220-, or 230-volt 50- to 60-cps operation. Refer to figure 7-1 for alternate connections.

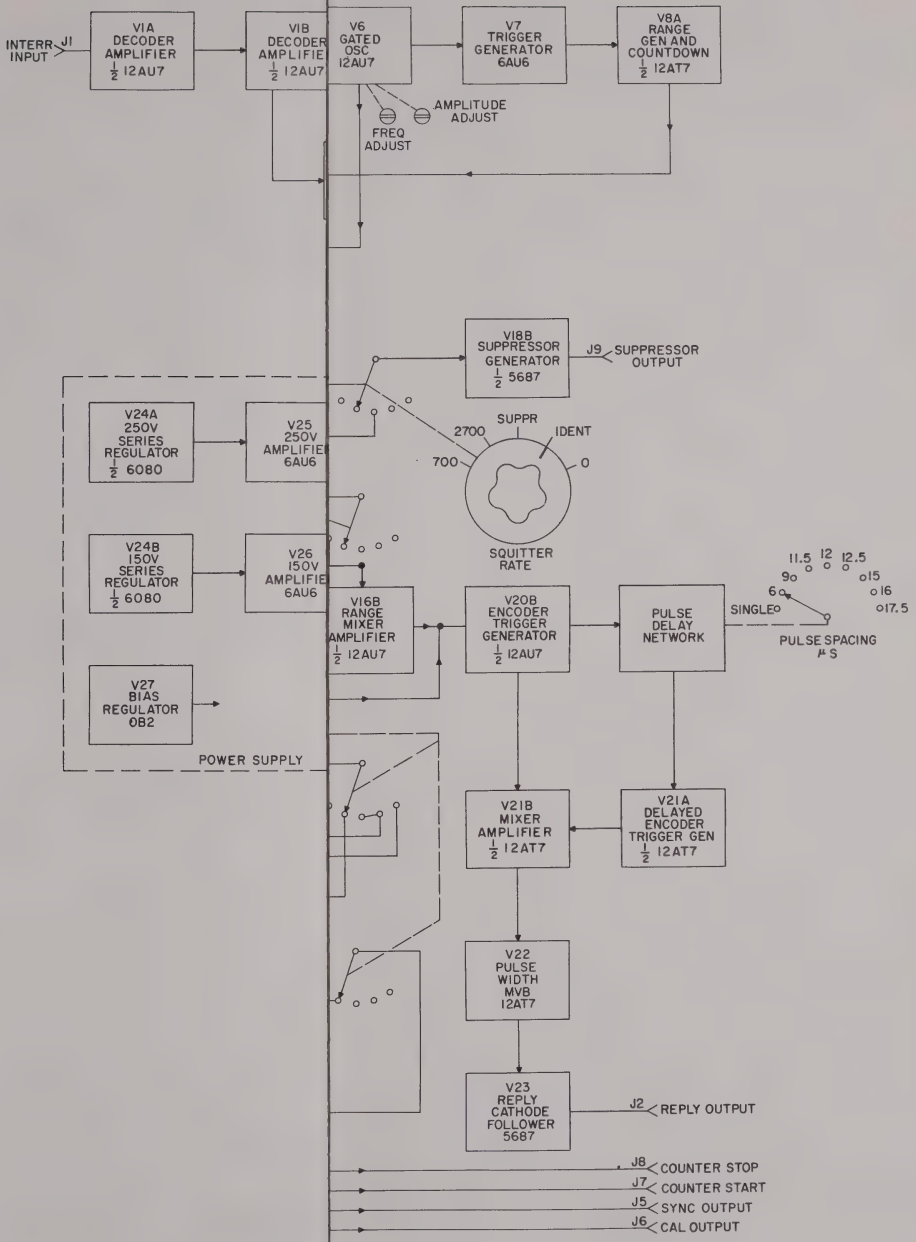

Figure 4-2. DME Bench Test Set 578D-1, Complete Block Diagram

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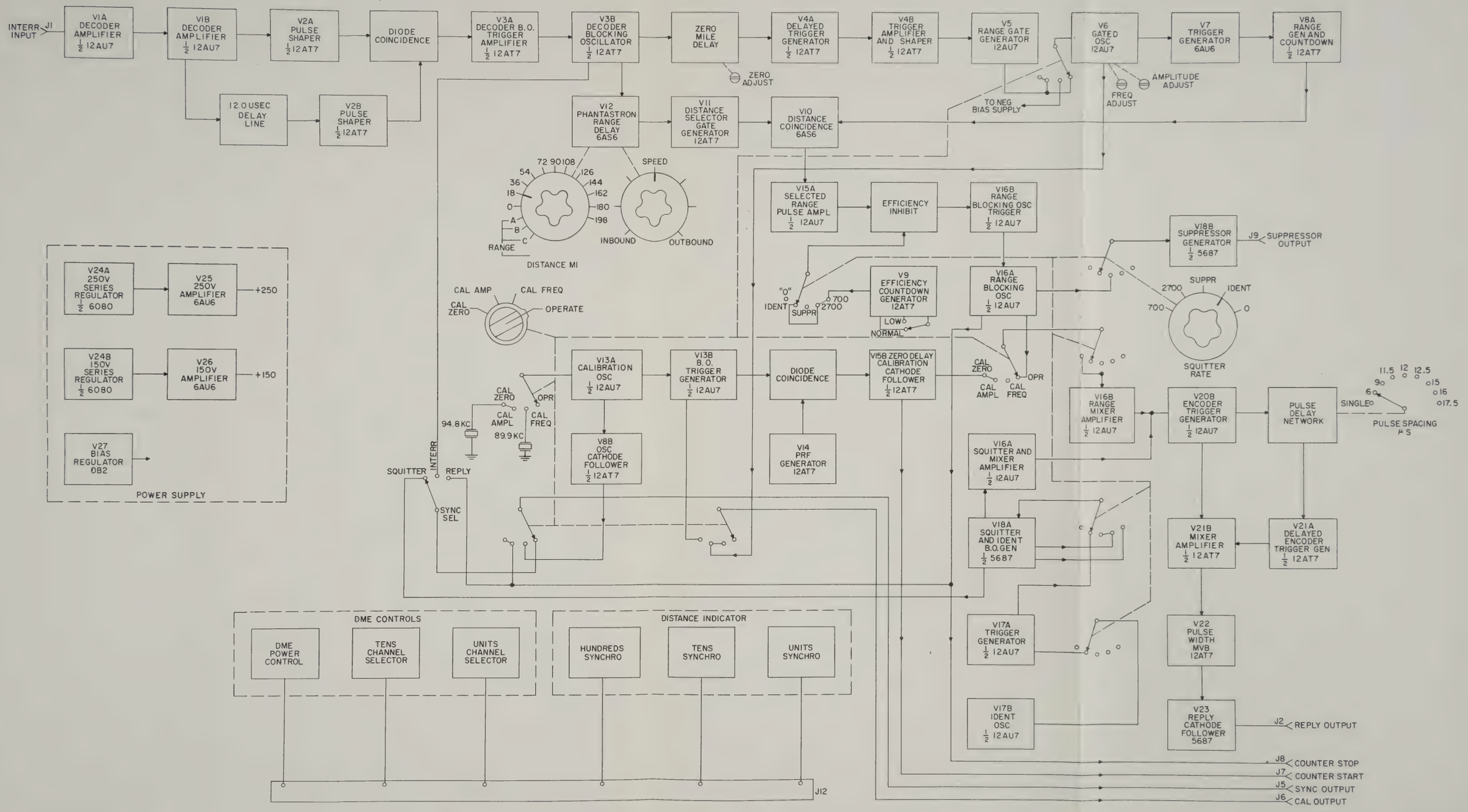
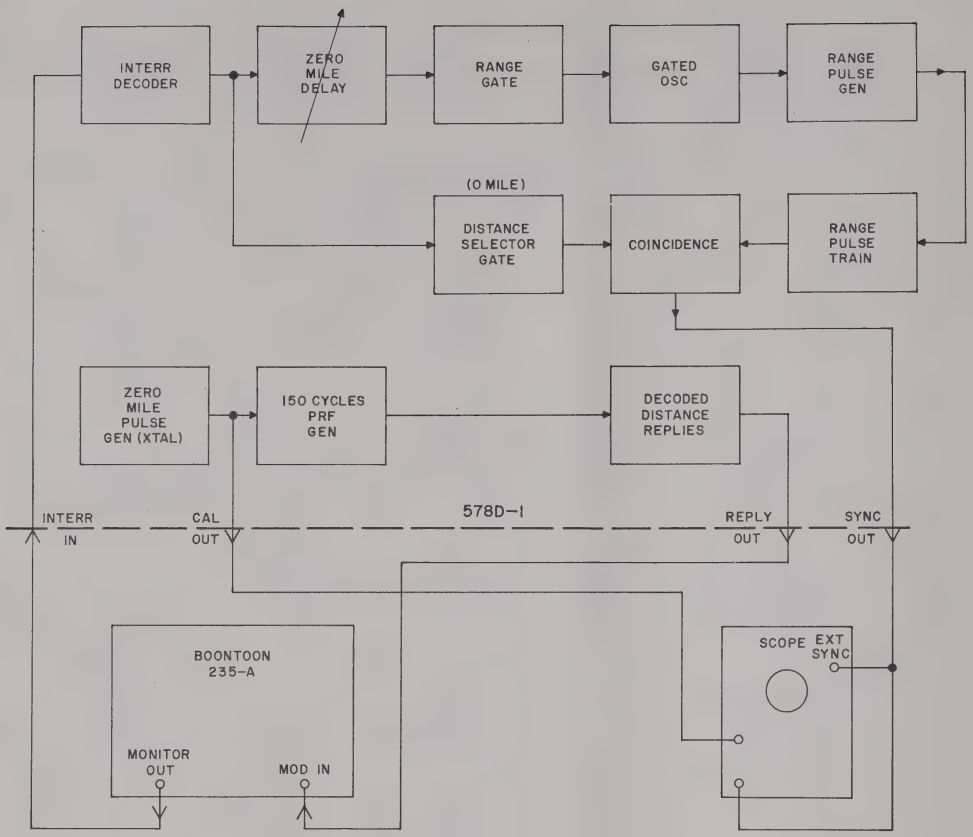


Figure 4-2. DME Bench Test Set 578D-1, Complete Block Diagram



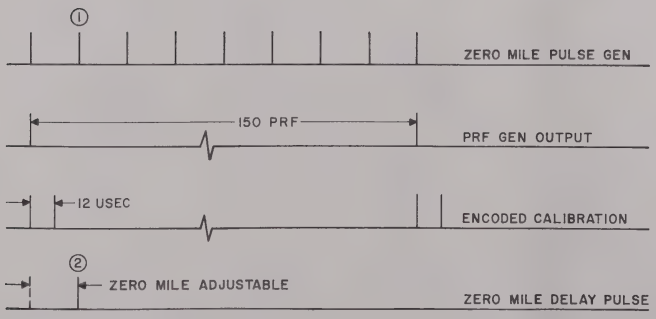


Figure 4-3. Zero Mile Calibration, Block Diagram

SECTION V
MAINTENANCE

5.1 GENERAL.

This section contains all adjustments and alignment procedures required to maintain DME Bench Test Set 578D-1. Information on adjustment and alignment of the DME under test is available in the associated instruction book. The overhaul procedures for the Collins DME, Radio Set 860E-1, are contained in the overhaul manual, Collins part number 523-0050-003. The following definitions apply to the test procedures contained in this section.

5.1.1 RISE TIME.

Rise time is the time between the 10-percent and 90-percent amplitude points on the leading edge of the pulse. Overshoot on the top of the pulse is not considered part of the amplitude.

5.1.2 DECAY TIME.

Decay time is the time between the 10-percent and 90-percent amplitude points on the trailing edge of the pulse.

5.1.3 PULSE WIDTH.

Pulse width is the time between the 50-percent voltage points on the leading edge and the trailing edge of the pulse.

5.1.4 PULSE SPACING.

Pulse spacing is the time between the 50-percent amplitude points on the leading edges of two consecutive pulses.

5.1.5 PULSE REPETITION FREQUENCY.

Pulse repetition frequency (prf) is the number of pulses per second.

5.1.6 INTERROGATION.

The normal interrogation for DME consists of two pulses with 12-microsecond pulse spacing.

5.2 TEST EQUIPMENT REQUIREMENTS.

Table 5-1 lists the test equipment required for testing, adjusting and trouble shooting DME Bench Test Set 578D-1. Suitable substitutes possessing equivalent accuracies may be used.

TABLE 5-1. TEST EQUIPMENT

EQUIPMENT	DESCRIPTION
Power sources	Variable 103-126 volts, 60 cps. 115 volts 400 cps.
Oscilloscope	Tektronix type 543 or 545 with type C-A dual trace plug-in head.
Voltohmmeter	Triplett model 630 calibrated at 250 volts d-c, 150 volts d-c, 108 volts d-c, 27 volts d-c, and 10 volts d-c to within ±0.5 percent.
Frequency counter	Hewlett-Packard 524B with 562B time interval unit.
Resistance bridge coaxial cables	RG-62A/U, with UG-88B connector at each end, (4 required).
BNC "T" connector	One arm terminated with 150-ohm ±5-percent resistance.
BNC "T" connector	One arm terminated with 2000-ohm ±5-percent resistance.
BNC "T" connector	One arm terminated with 237-kilohm ±10-percent resistance.
Voltmeter	0-15 volts a-c, Weston model 904.
Time mark generator	Collins ATC Transponder Bench Test Set 578X-1.

5.3 ADJUSTMENTS AND TESTS.

WARNING

Operation of the 578D-1 and associated DME equipment involves voltages that are dangerous to life. When performing maintenance procedures, special care must be taken to avoid contact with circuits carrying high voltages.

The following adjustment procedures should be performed periodically on the 578D-1 to ensure proper operation. They should also be performed after replacement of components in the 578D-1.

NOTE

If components are replaced in the 235-A, check the zero mile delay adjustment given in paragraph 5.3.8.

For alignment and adjustment of the 235-A refer to the 235-A handbook.

5.3.1 FUSES.

Check fuses F2, F3, and F4 on the front panel and F1 on the rear apron of the 578D-1 chassis. Ensure that they are the proper value and continuous; see table 1-6.

NOTE

All fuses are slo-blo type.

5.3.2 POWER SUPPLY ADJUSTMENTS.

a. Adjust R216 to obtain +150 ±1 volts d-c at J14.
b. Adjust R207 to obtain +250 ±1 volts d-c at J13.

5.3.3 CALIBRATION NETWORK.

a. Set the calibrate selector to CAL ZERO position.
b. Move the TEST SET ON-OFF switch to ON position.
c. Connect the frequency counter to test point J28.
d. Slowly adjust R129 from the maximum counterclockwise position to the maximum clockwise position, and note carefully the shaft positions over which the frequency counter remains at 19.7 kilocycles. Set the potentiometer at the midpoint of this range. The range should cover at least 90 degrees.
e. Set the calibration selector to CAL FREQ position.
f. Connect the oscilloscope to the SCOPE SYNC OUTPUT of the 578D-1.
g. Set the horizontal sweep rate of the oscilloscope to 200 microseconds per centimeter.
h. Adjust R124 of the 578D-1 to obtain an indication of 18 ±8 volts peak on the oscilloscope.

5.3.4 IDENTIFICATION AND SQUITTER NETWORKS.

a. Connect the frequency counter to the SCOPE SYNC OUTPUT, J5, on the 578D-1.
b. Set the calibration selector of the 578D-1 to OPERATE position.
c. Set the SYNC SELECTOR of the 578D-1 to SQUITTER position.
d. Set the SQUITTER RATE selector of the 578D-1 to IDENT position, and adjust R156, IDENT control, to obtain 1350 ±5 pps on the frequency counter.
e. Set the SQUITTER RATE selector of the 578D-1 to 700, and adjust R168 to obtain 735 ±5 pps on the frequency counter.
f. Set the SQUITTER RATE selector of the 578D-1 to 2700 position, and adjust R165 to obtain 2700 ±20 pps on the frequency counter.

5.3.5 ENCODER NETWORK.

a. Connect the 578D-1 and test equipment as shown in figure 5-1.
b. Set the SQUITTER RATE selector of the 578D-1 to 0 position.
c. Set the calibration selector to OPERATE position.
d. Set the REPLY EFFICIENCY selector to NORMAL position.
e. Set the DISTANCE-MI selector to RANGE A. Set the speed control to midpoint (12 o'clock position).
f. Set the PULSE SPACING-USEC selector to 6. Set R205 (located at rear of 578D-1) for maximum output level.
g. Set the INTERROGATION RATE selector of the 578X-1 to the 140 INTERROGATIONS/SEC position.
h. Adjust the vertical input gains of the oscilloscope so that both the 578D-1 reply pulses and the 578X-1 marker pulses occupy the maximum vertical height of the calibrated scope face.
i. Adjust the horizontal sweep of the oscilloscope for 0.1 microsecond per centimeter, and adjust the delayed sweep control on the oscilloscope for pulse position.
j. Adjust the MARKER POSITION of the 578X-1 so that the 50-percent point of the leading edge of one of the markers and the 50-percent point of the leading edge of the first reply pulse of the 578D-1 coincide. Using the marker pulses to define 10 centimeters of the oscilloscope face, adjust C116 of the 578D-1 to obtain a reply pulse width of 3.5 ±0.1 microseconds.
k. Set the PULSE SPACING-USEC of the 578D-1 to the 17.5 position. Adjust the delayed sweep control of the oscilloscope so that the leading edge of the second reply pulse of the 578D-1 is in view on the oscilloscope. Using the adjacent marker pulses as reference spacing, adjust C110 of the 578D-1 to obtain a pulse spacing of 17.5 ±0.03 microseconds.

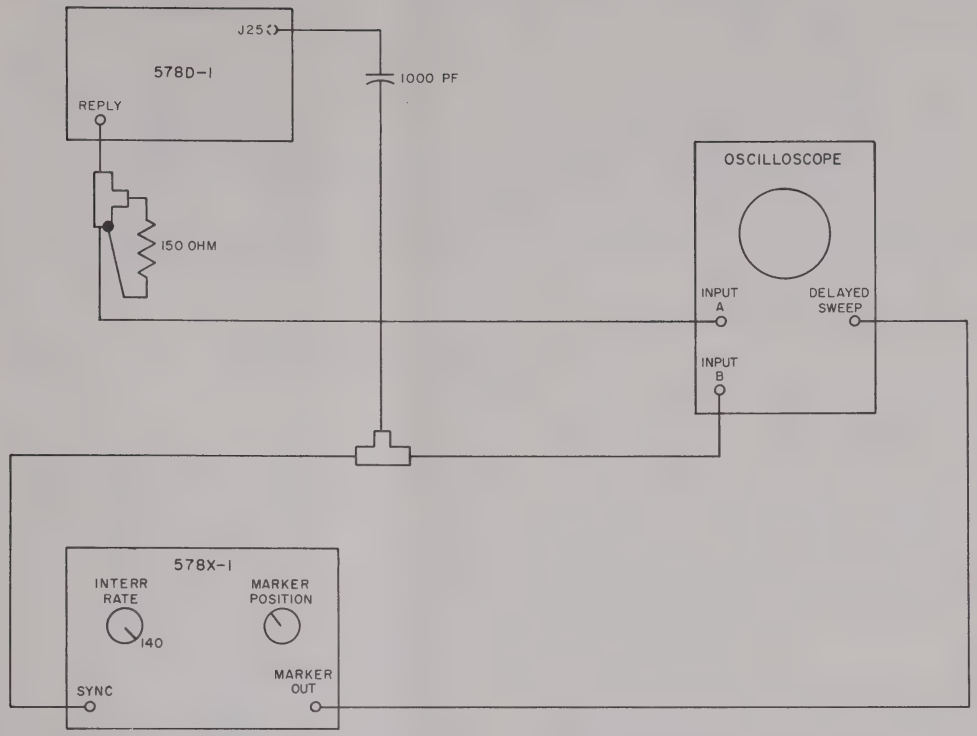


Figure 5-1. Encoder Network Adjustment, Block Diagram

1. Repeat the procedure of step k above for each setting of the PULSE SPACING-USEC control. Adjust the associated capacitor in each case.

PULSE SPACING-USEC	ASSOCIATED CAPACITOR
16 ±0.03 usec	C109
15 usec	C108
12.5 usec	C107
12.0 usec	C106
11.5 usec	C105
9.0 usec	C104
6.0 ±0.4 usec	C103

5.3.6 RANGE NETWORK BLOCKING OSCILLATOR.

a. Connect the 578D-1 as shown in figure 5-2.
b. Set the calibrate selector of the 578D-1 to OPERATE position.
c. Set the INTERROGATION RATE selector of the 578X-1 to 30 INTERROGATIONS/SEC.
d. Set the oscilloscope as follows:

(1) Vertical input to B.
(2) Internal synchronization.
(3) Vertical gain to 5 volts per centimeter.
(4) Horizontal sweep to 500 microseconds per centimeter.

e. Adjust R46 of the 578D-1 to obtain an indication of constant pulsed oscillator amplitude (during the period of oscillation which is approximately 3 milliseconds).
f. Set the oscilloscope as follows:

(1) Vertical input to A.
(2) Delayed sweep.
(3) Vertical gain 50 volts per centimeter.
(4) Horizontal sweep to 20 microseconds per centimeter.

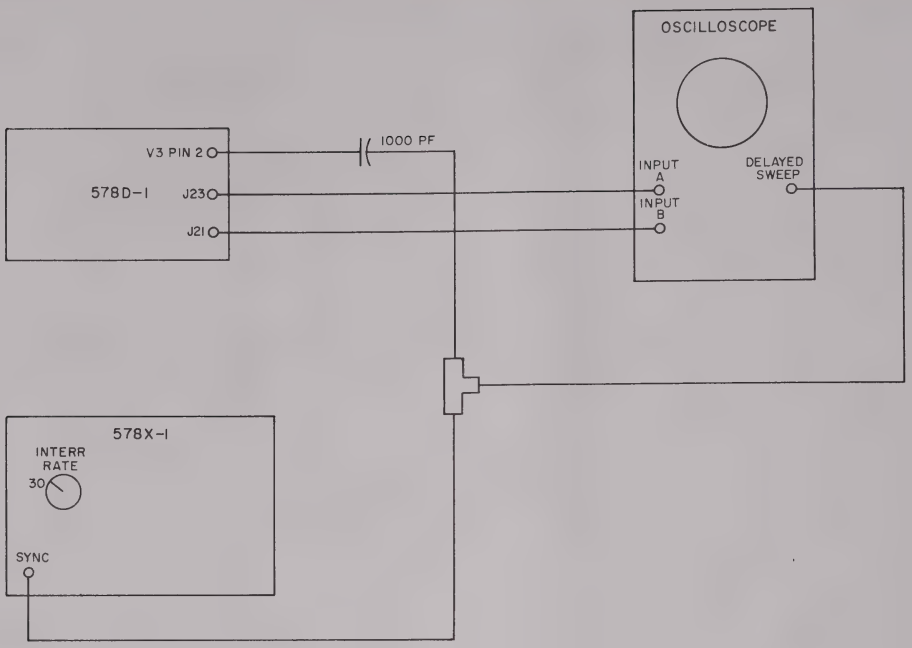


Figure 5-2. Range Blocking Oscillator Adjustment, Block Diagram

g. Adjust the delayed sweep on the oscilloscope so as to observe the first pulse of the pulse train. Then set R64 of the 578D-1 to full clockwise position. R64 is located on main chassis of 578D-1. Rotate the shaft of R64 counterclockwise until the blocking oscillator countdown is 111.2 microseconds (5 to 1), and note the position of the shaft.

h. Set the INTERROGATION RATE selector of the 578X-1 to the 140 INTERROGATIONS/USEC position.

i. Set R64 of the 578D-1 fully counterclockwise. Rotate the shaft of R64 clockwise until the blocking oscillator countdown is 111.2 microseconds (5 to 1), and note the position of the shaft.

j. Position the shaft of R64 to the midpoint of the positions noted in steps g and i. Lock the potentiometer shaft with the locking device provided.

5.3.7 PULSED OSCILLATOR.

a. Connect the 578D-1 as shown in figure 5-3.

b. Set the calibration selector to CAL AMP position.

c. Set the PULSE SPACING-USEC selector of the 578D-1 to 12.

d. Set the DISTANCE-MI selector of the 578D-1 to 0.

e. Set the REPLY EFFICIENCY to NORMAL position.

f. Set the oscilloscope as follows:

(1) Vertical input to A.
(2) Internal synchronization.
(3) Vertical gain control to 0.5 volt per centimeter.
(4) Horizontal sweep to 2 microseconds per centimeter.

g. Adjust R205 of the 578D-1 to obtain an output amplitude of 1 volt peak as indicated on the oscilloscope.

h. Set the oscilloscope as follows:

(1) Vertical input to B.
(2) External sync.
(3) Vertical sensitivity to 5 volts per centimeter.
(4) Horizontal sweep to 500 microseconds per centimeter.

i. Note the amplitude of the gated oscillator signal.

j. Set the calibration selector to CAL FREQ position.

k. Set the oscilloscope to internal synchronization. Adjust R46 of the 578D-1 to obtain the same amplitude (approximately) signal as noted in step i.

l. Connect the SCOPE SYNC OUTPUT, J5 of the 578D-1 to the external sweep input of the oscilloscope.

m. Adjust C32 of the 578D-1 to obtain a 2-to-1 Lissajous pattern on the oscilloscope. This pattern will appear as a figure eight.

5.3.8 ZERO DELAY.

a. Connect the 578D-1 and oscilloscope as shown in figure 5-3, except disconnect the lead from input A on the oscilloscope to the INTERR INPUT on the 578D-1. Connect the SCOPE SYNC OUTPUT on the 578D-1 to input A on the oscilloscope.

b. Set the calibration selector of the 578D-1 to CAL ZERO position.

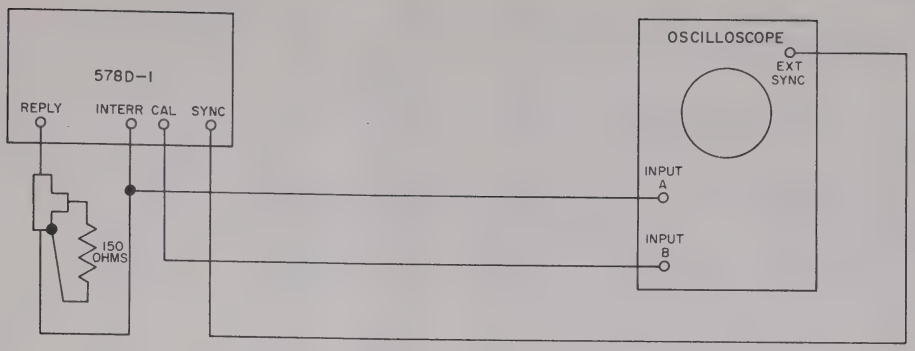


Figure 5-3. Pulse Oscillation Adjustment, Block Diagram

c. Set the vertical input gain control of input A on the oscilloscope to 20 volts per centimeter. Adjust the variable gain (input A) of the oscilloscope to obtain a pulse amplitude display 4 centimeters high.

d. Set the vertical input gain control of input B on the oscilloscope to 10 volts per centimeter. Adjust the variable gain (input B) of the oscilloscope to obtain a pulse amplitude display 4 centimeters high.

e. Set the horizontal sweep for 0.1 microsecond per centimeter. Set the vertical input for input A and input B.

f. Adjust C16 of the 578D-1 to 1/2 mesh.

g. Select the position of S6 on the 578D-1 which gives the minimum spacing between the leading edges of the pulses at the 50-percent amplitude points.

h. Adjust C16 to superimpose the 50-percent amplitude points of the leading edges of the pulses as displayed on the oscilloscope.

5.3.9 PHANTASTRON DELAY NETWORK.

a. Connect the 578D-1 and oscilloscope as shown in figure 5-4.

b. Set the calibrate selector to CAL ZERO position. Set the DISTANCE-MI selector to 18.

c. Set the oscilloscope as follows:

(1) Vertical input to position A.

(2) Horizontal sweep to 50 microseconds per centimeter.

(3) Sweep delay to obtain the image of the first pulse of the train.

(4) Vertical gain to yield a pulse amplitude image 4 centimeters high.

d. Switch the oscilloscope to input B. Adjust the B input gain to obtain a gate signal amplitude image 4 centimeters high.

e. Set the horizontal sweep to 20 microseconds per centimeter. Center the third pulse of the pulse train on the oscilloscope by adjusting the delayed sweep control.

f. Set the oscilloscope for A and B input, and adjust R101 of the 578D-1 to center the gate over the third pulse of the pulse train.

g. Set the DISTANCE-MI of the 578D-1 to 198. Adjust the delayed sweep on the oscillocope until the 23rd pulse of the pulse train is centered on the oscilloscope.

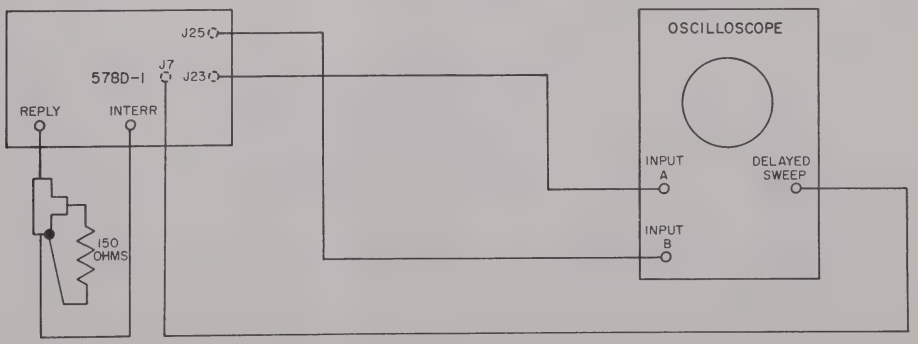


Figure 5-4. Phantastron Adjustment, Block Diagram

h. Adjust R96 of the 578D-1 to center the gate over the 23rd pulse of the pulse train.

i. Set the DISTANCE-MI selector of the 578D-1 to 18.

j. Center the third pulse of the pulse train on the oscilloscope by adjusting the delayed sweep control of the oscilloscope.

k. Adjust R101 of the 578D-1 to center the gate over the third pulse of the pulse train.

l. Repeat steps g through k until no further improvement can be made.

m. Measure the gate pulse width on all fixed distance positions of the DISTANCE-MI selector. The gate pulse width should be between 75 and 115 microseconds.

5.3.10 EFFICIENCY NETWORK CALIBRATION.

a. Connect the 578D-1 and frequency counter as shown in figure 5-5.

b. Set the SQUITTER RATE switch to 2700 and the calibration selector to the CAL ZERO position.

c. Record the indication on the frequency counter.

d. Connect the frequency counter to J8 on the 578D-1.

e. Set the REPLY EFFICIENCY switch to NORMAL, and adjust R72 for an average indication equal to 70 percent of the indication recorded in step c.

f. Set the REPLY EFFICIENCY switch to LOW, and adjust R259 for an average indication equal to 50 percent of the indication recorded in step c.

5.4 TESTS.

5.4.1 VOLTAGE CHECKS.

Check the voltages between the test points indicated in table 5-2 and chassis ground. The proper voltages are given in table 5-2.

TABLE 5-2
TEST POINT VOLTAGES

JACK NO.	VOLTAGE AND TOLERANCE
J13	+250 ±1 volt
J14	+150 ±1 volt
J15	-108 ±4 volts
J16	-27 ±1 volt
J17	-15 +1 volt
J18	-10 ±1 volt
J39	6.3 ±0.1 volt a-c

5.4.2 WAVEFORMS.

Check the waveforms present at test points J19 through J32. The waveforms are illustrated in figure 5-6. The waveforms should be approximately the same as those illustrated in figure 5-6 but may vary somewhat due to random noise and individual unit characteristics.

The standard output waveforms should conform with the definitions of paragraphs 5.1.1 through 5.1.6.

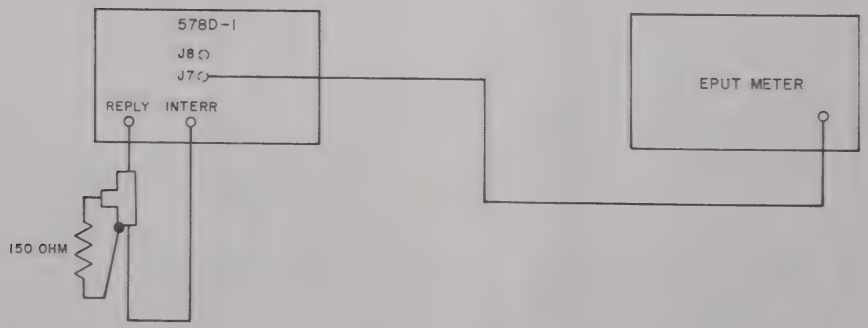


Figure 5-5. Efficiency Network Adjustment, Block Diagram

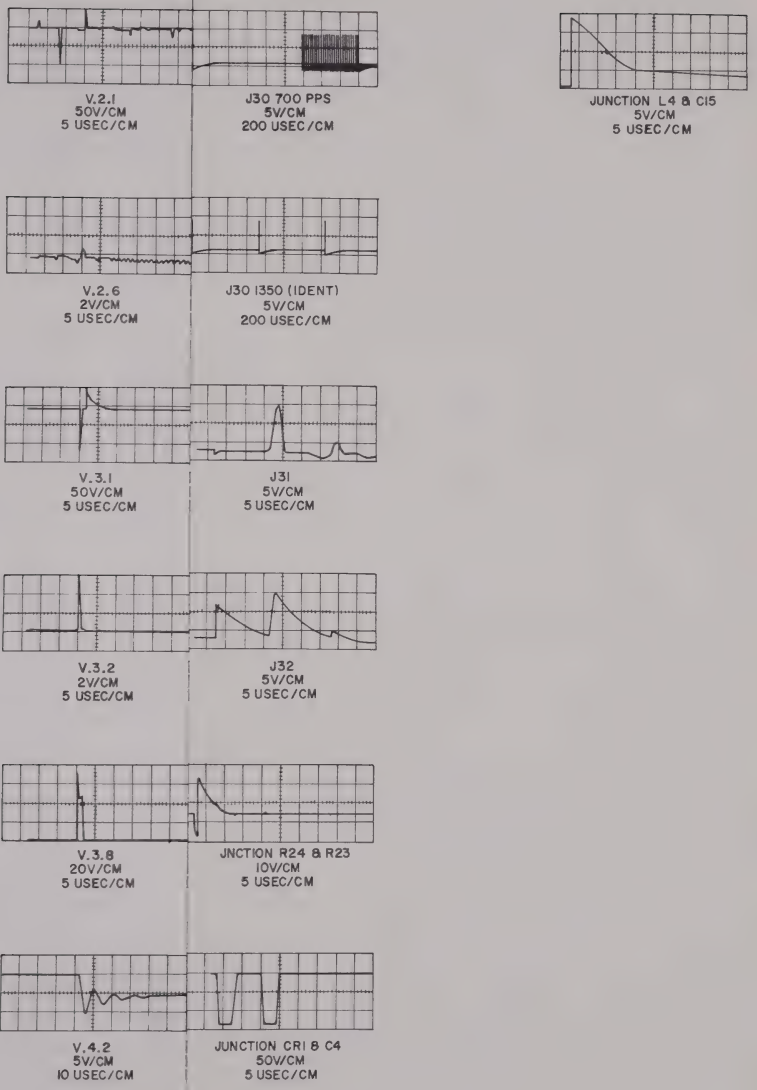


Figure 5-6. Waveforms

h. Adjust R96 of the 578D-1 to center the gate over the 23rd pulse of the pulse train.

i. Set the DISTANCE-MI selector of the 578D-1 to 18.

j. Center the third pulse of the pulse train on the oscilloscope by adjusting the delayed sweep control of the oscilloscope.

k. Adjust R101 of the 578D-1 to center the gate over the third pulse of the pulse train.

l. Repeat steps g through k until no further improvement can be made.

m. Measure the gate pulse width on all fixed distance positions of the DISTANCE-MI selector. The gate pulse width should be between 75 and 115 microseconds.

5.3.10 EFFICIENCY NETWORK CALIBRATION.

a. Connect the 578D-1 and frequency counter as shown in figure 5-5.

b. Set the SQUITTER RATE switch to 2700 and the calibration selector to the CAL ZERO position.

c. Record the indication on the frequency counter.

d. Connect the frequency counter to J8 on the 578D-1.

e. Set the REPLY EFFICIENCY switch to NORMAL, and adjust R72 for an average indication equal to 70 percent of the indication recorded in step c.

f. Set the REPLY EFFICIENCY switch to LOW, and adjust R259 for an average indication equal to 50 percent of the indication recorded in step c.

5.4 TESTS.

5.4.1 VOLTAGE CHECKS.

Check the voltages between the test points indicated in table 5-2 and chassis ground. The proper voltages are given in table 5-2.

TABLE 5-2
TEST POINT VOLTAGES

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J16	-27 ±1 volt
J17	-15 +1 volt
J18	-10 ±1 volt
J39	6.3 ±0.1 volt a-c

5.4.2 WAVEFORMS.

Check the waveforms present at test points J19 through J32. The waveforms are illustrated in figure 5-6. The waveforms should be approximately the same as those illustrated in figure 5-6 but may vary somewhat due to random noise and individual unit characteristics.

The standard output waveforms should conform with the definitions of paragraphs 5.1.1 through 5.1.6.

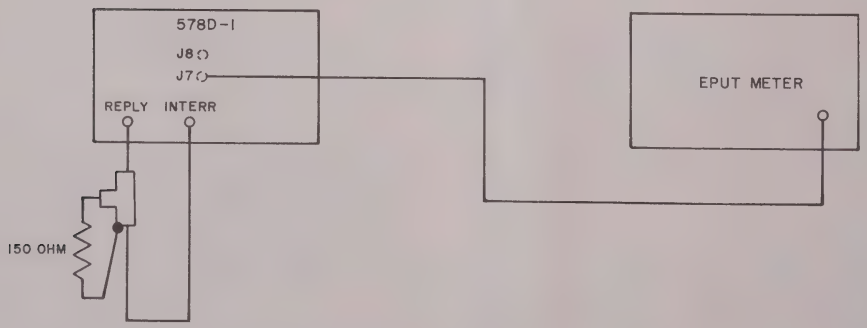
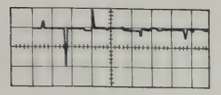
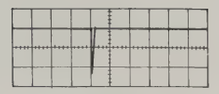
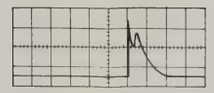


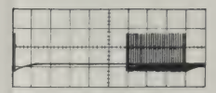
Figure 5-5. Efficiency Network Adjustment, Block Diagram

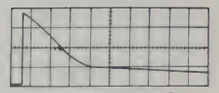

V.2.1
50V/CM
5 USEC/CM

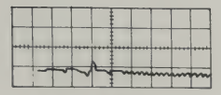

V.4.6
50V/CM
10 USEC/CM

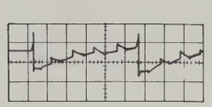

V.16.7 (100%)
10V/CM
5 USEC/CM

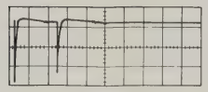
J22
20V/CM
20 USEC/CM

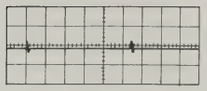

J30 700 PPS
5V/CM
200 USEC/CM

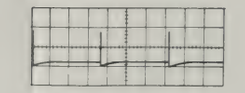

JUNCTION L4 & C15
5V/CM
5 USEC/CM

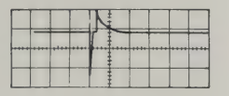

V.2.6
2V/CM
5 USEC/CM

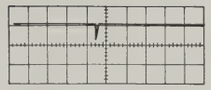

V.8.2
50V/CM
20 USEC/CM

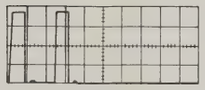

V.21.6
20V/CM
5 USEC/CM

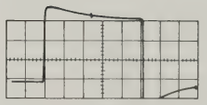

J23
50V/CM
20 USEC/CM

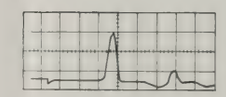

J30 1350 (IDENT)
5V/CM
200 USEC/CM

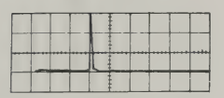

V.3.1
50V/CM
5 USEC/CM

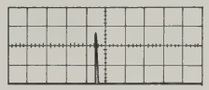

V.10.5
20V/CM
20 USEC/CM

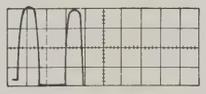

V.22.6
20V/CM
5 USEC/CM

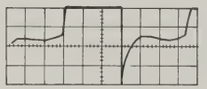

J25
20V/CM
20 USEC/CM

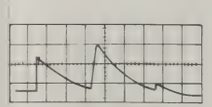

J31
5V/CM
5 USEC/CM

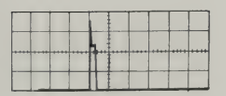

V.3.2
2V/CM
5 USEC/CM

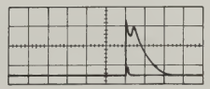

V.15.1
20V/CM
20 USEC/CM

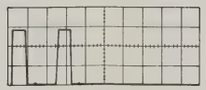

INTERR INPUT-J1
1V/CM
5 USEC/CM

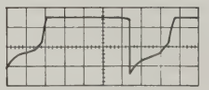

J26 (50% EFF)
50V/CM
5 MILL/CM

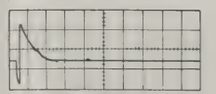

J32
5V/CM
5 USEC/CM

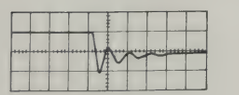

V.3.8
20V/CM
5 USEC/CM

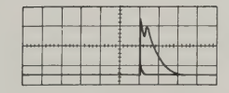

V.16.7 (50%)
10V/CM
5 USEC/CM

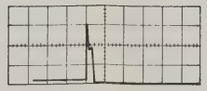

J2
5V/CM
5 USEC/CM

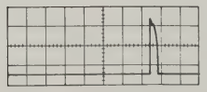

J26 (75% EFF)
50V/CM
5 MILL/CM


JNCTION R24 & R23
10V/CM
5 USEC/CM


V.4.2
5V/CM
10 USEC/CM


V.16.7 (70%)
10V/CM
5 USEC/CM


J19
5V/CM
5 USEC/CM


J27
5V/CM
5 USEC/CM

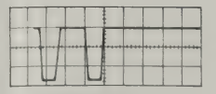

JUNCTION CR1 & C4
50V/CM
5 USEC/CM

Figure 5-6. Waveforms

SECTION VI
PARTS LIST

DME Bench Test Set 578D-1

ITEM	DESCRIPTION	COLLINS PART NUMBER
	DME BENCH TEST SET	522-1838-006
B1	SYNCHRO, RECEIVER: single phase rotor, wye connected three phase stator; 26.0 v, 400 cps, .5 watt max power, 100 ma max current; Kearfott part no. R-925-21N	229-0166-00
B2	SYNCHRO, RECEIVER: same as B1	229-0166-00
B3	SYNCHRO, RECEIVER: same as B1	229-0166-00
B4	MOTOR, DIRECT CURRENT: 27.5 v dc w/ 3/4 RPM gear train; 30 milliamp current; continuous duty; cw rotation; Cramer Control part no. 800-1696	230-0361-00
C1	NOT USED	
C2	CAPACITOR, FIXED, MICA: 10,000 uuf ±5%, 500 vdcw; Electro Motive part no. DM30F103	912-2735-00
C3	CAPACITOR, FIXED, PAPER: 0.33 uf ±20%, 400 vdcw	931-1652-00
C4	CAPACITOR, FIXED, MICA: same as C2	912-2735-00
C5	CAPACITOR, FIXED, CERAMIC: 0.02 uf -20% +100%, 500 vdcw; Sprague Electric Co. part no. 33C2	913-2142-00
C6	CAPACITOR, FIXED, MICA: 10 uuf ±5%, 500 vdcw; Electro Motive part no. DM15C100J01	912-2753-00
C7	CAPACITOR, FIXED, CERAMIC: same as C5	913-2142-00
C8	CAPACITOR, FIXED, MICA: same as C2	912-2735-00
C9	CAPACITOR, FIXED, MICA: same as C2	912-2735-00
C10	CAPACITOR, FIXED, CERAMIC: same as C5	913-2142-00
C11	CAPACITOR, FIXED, MICA: 470 uuf ±5%, 300 vdcw; Electro Motive part no. DM15F471J01	912-2864-00
C12	CAPACITOR, FIXED, CERAMIC: same as C5	913-2142-00
C13	CAPACITOR, FIXED, CERAMIC: 5 uuf ±.5 uuf, 500 vdcw	913-0299-00
C14	CAPACITOR, FIXED, CERAMIC: same as C5	913-2142-00
C15	CAPACITOR, FIXED, MICA: same as C2	912-2735-00
C16	CAPACITOR, AIR, VARIABLE: 6.0 uuf min to 75 uuf max, 500 vdcw	922-0546-00
C17	CAPACITOR, FIXED, MICA: 270 uuf ±5%, 500 vdcw; Electro Motive part no. DM15F271J01	912-2846-00
C18	CAPACITOR, FIXED, MICA: 180 uuf ±5%, 500 vdcw; Electro Motive part no. DM15F181J01	912-2834-00
C19	CAPACITOR, FIXED, MICA: 91 uuf ±5%, 500 vdcw; Electro Motive part no. DM15F910J01	912-2813-00
C20	CAPACITOR, FIXED, MICA: 360 uuf ±5%, 500 vdcw; Electro Motive part no. DM15F361J01	912-2855-00
C21	CAPACITOR, FIXED, MICA: same as C20	912-2855-00
C22	CAPACITOR, FIXED, MICA: same as C19	912-2813-00
C23	CAPACITOR, FIXED, MICA: same as C20	912-2855-00
C24	CAPACITOR, FIXED, MICA: same as C19	912-2813-00
C25	CAPACITOR, FIXED, MICA: 3300 uuf ±2%, 500 vdcw; Electro Motive part no. DM20F332G	912-3353-00
C26	CAPACITOR, FIXED, CERAMIC: same as C5	913-2142-00
C27	CAPACITOR, FIXED, CERAMIC: same as C5	913-2142-00
C28	CAPACITOR, FIXED, MICA: same as C2	912-2735-00
C29	CAPACITOR, FIXED, PAPER: 0.1 uf ±20%, 300 vdcw	931-4530-00
C30	CAPACITOR, FIXED, MICA: 2400 uuf ±5%, 500 vdcw; Electro Motive part no. DM20F242J	912-3342-00
C31	CAPACITOR, FIXED, MICA: 12 uuf ±5%, 500 vdcw; Electro Motive part no. DM15F120J01	912-2756-00
C32	CAPACITOR, VARIABLE, AIR: 7 uuf min to 100 uuf max, 600 v rms	922-0156-00
C33	CAPACITOR, FIXED, MICA: 1000 uuf ±2%, 500 vdcw; Electro Motive part no. DM20F102G	912-3314-00
C34	CAPACITOR, FIXED, PAPER: 0.1 uf ±20%, 100 vdcw; Sprague Electric part no. 196P10401S4	931-4488-00
C35	CAPACITOR, FIXED, PAPER: same as C34	931-4488-00
C36	CAPACITOR, FIXED, CERAMIC: same as C13	913-0299-00
C37	CAPACITOR, FIXED, MICA: 150 uuf ±5%, 500 vdcw; Electro Motive part no. DM15F151J01	912-2828-00
C38	CAPACITOR, FIXED, CERAMIC: same as C13	913-0299-00
C39	CAPACITOR, FIXED, MICA: 100 uuf ±5%, 500 vdcw; Electro Motive part no. DM15F101J01	912-2816-00
C40	CAPACITOR, FIXED, ELECTROLYTIC: 2 uf -10%, +100%, 350 vdcw; Sprague Electric part no. S74229	183-0787-00
C41	CAPACITOR, FIXED, CERAMIC: 160 uuf ±5%, 500 vdcw	928-7341-00
C42	CAPACITOR, FIXED, PAPER: 0.22 uf ±20%, 100 vdcw; Sprague Electric part no. 196P22401S4	931-4492-00
C43	CAPACITOR, FIXED, CERAMIC: same as C13	913-0299-00
C44	CAPACITOR, FIXED, MICA: same as C37	912-2828-00
C45	CAPACITOR, FIXED, PAPER: 0.047 uf ±10%, 400 vdcw; Sprague Electric Co. part no. 160P47394	931-0295-00
C46	CAPACITOR, FIXED, PAPER: same as C45	931-0295-00
C47	CAPACITOR, FIXED, PAPER: same as C34	931-4488-00
C48	CAPACITOR, FIXED, MICA: same as C11	912-2864-00
C49	CAPACITOR, FIXED, PAPER: 0.22 uf ±10%, 400 vdcw; Sprague Electric part no. 160P22494	931-0303-00
C50	CAPACITOR, FIXED, MICA: same as C2	912-2735-00
C51	CAPACITOR, FIXED, CERAMIC: same as C5	913-2142-00
C52	CAPACITOR, FIXED, MICA: 20 uuf ±5%, 500 vdcw; Electro Motive part no. DM15F200J01	912-2765-00
C53	CAPACITOR, FIXED, MICA: same as C17	912-2846-00
C54	CAPACITOR, FIXED, MICA: same as C39	912-2816-00
C55	CAPACITOR, FIXED, PAPER: same as C49	931-0303-00
C56	CAPACITOR, FIXED, MICA: 47 uuf ±5%, 500 vdcw; Electro Motive part no. DM15F470J01	912-2792-00
C57	CAPACITOR, FIXED, MICA: 1000 uuf ±5%, 500 vdcw; Electro Motive part no. DM20F102J	912-3315-00
C58	CAPACITOR, FIXED, MICA: 2200 uuf ±2%, 500 vdcw; Electro Motive part no. DM20F222G	912-3338-00
C59	CAPACITOR, FIXED, MICA: 680 uuf ±2%, 500 vdcw; Electro Motive part no. DM20F681G	912-3302-00
C60	CAPACITOR, FIXED, MICA: 2000 uuf ±2%, 500 vdcw; Electro Motive part no. DM20F202G	912-3335-00
C61	CAPACITOR, FIXED, MICA: 1300 uuf ±2%, 500 vdcw; Electro Motive part no. DM20F132G	912-3323-00
C62	CAPACITOR, FIXED, MICA: same as C57	912-3315-00
C63	NOT USED	
C64	CAPACITOR, FIXED, MICA: same as C57	912-3315-00
C65	CAPACITOR, FIXED, CERAMIC: same as C13	913-0299-00
C66	CAPACITOR, FIXED, CERAMIC: same as C13	913-0299-00
C67	CAPACITOR, FIXED, MICA: same as C37	912-2828-00
C68	CAPACITOR, FIXED, MICA: 430 uuf ±2%, 300 vdcw; Electro Motive part no. DM15F431G01	912-2860-00
C69	CAPACITOR, FIXED, MICA: same as C39	912-2816-00
C70	CAPACITOR, FIXED, MICA: same as C11	912-2864-00
C71	CAPACITOR, FIXED, CERAMIC: same as C13	913-0299-00
C72	CAPACITOR, FIXED, PAPER: same as C29	931-4530-00
C73	CAPACITOR, FIXED, MICA: 300 uuf ±5%, 500 vdcw; Electro Motive part no. DMF15F301J01	912-2849-00
C74	CAPACITOR, FIXED, MICA: same as C11	912-2864-00
C75	CAPACITOR, FIXED, MICA: same as C18	912-2834-00
C76	CAPACITOR, FIXED, MICA: same as C57	912-3315-00
C77	CAPACITOR, FIXED, MICA: same as C11	912-2864-00
C78	CAPACITOR, FIXED, MICA: same as C11	912-2864-00
C79	CAPACITOR, FIXED, MICA: same as C11	912-2864-00
C80	CAPACITOR, FIXED, CERAMIC: same as C13	913-0299-00
C81	CAPACITOR, FIXED, MICA: same as C39	912-2816-00
C82	CAPACITOR, FIXED, MICA: same as C33	912-3314-00
C83	CAPACITOR, FIXED, MICA: 430 uuf ±2%, 300 vdcw; Electro Motive part no. DM15F431G01	912-2860-00
C84	CAPACITOR, FIXED, MICA: 220 uuf ±2%, 500 vdcw; Electro Motive part no. DM15F221G01	912-2839-00
C85	CAPACITOR, FIXED, MICA: 110 uuf ±2%, 500 vdcw; Electro Motive part no. DM15F111G01	912-2818-00
C86	CAPACITOR, FIXED, MICA: same as C2	912-2735-00
C87	CAPACITOR, FIXED, PAPER: same as C34	931-4488-00
C88	CAPACITOR, FIXED, MICA: same as C30	912-3342-00
C89	CAPACITOR, FIXED, MICA: same as C30	912-3342-00
C90	CAPACITOR, FIXED, CERAMIC: same as C5	913-2142-00
C91	CAPACITOR, FIXED, MICA: same as C11	912-2864-00
C92	CAPACITOR, FIXED, PAPER: 1.0 uf ±10%, 600 vdcw	930-0080-00
C93	CAPACITOR, FIXED, MICA: same as C11	912-2864-00
C94	CAPACITOR, FIXED, CERAMIC: same as C13	913-0299-00
C95	CAPACITOR, FIXED, MICA: same as C11	912-2864-00
C96	CAPACITOR, FIXED, MICA: 6800 uuf ±5%, 500 vdcw; Electro Motive part no. DM30F682J	912-2723-00
C97	CAPACITOR, FIXED, MICA: 68 uuf ±5%, 500 vdcw; Electro Motive part no. DM15F680J01	912-2804-00
C98	CAPACITOR, FIXED, MICA: same as C84	912-2839-00
C99	CAPACITOR, FIXED, MICA: same as C18	912-2834-00
C100	CAPACITOR, FIXED, MICA: same as C11	912-2864-00
C101	CAPACITOR, FIXED, MICA: same as C84	912-2839-00
C102	CAPACITOR, FIXED, MICA: 430 uuf ±5%, 300 vdcw; Electro Motive part no. DM15F431J01	912-2861-00

DME Bench Test Set 578D-1

ITEM	DESCRIPTION	COLLINS PART NUMBER
C103	CAPACITOR, VARIABLE, CERAMIC: 8.0 uuf min to 75.0 uuf max, 350 vdcw	912-1075-00
C104	CAPACITOR, VARIABLE, CERAMIC: same as C103	917-1075-00
C105	CAPACITOR, VARIABLE, MICA: 120 uuf min. max. at 1-1/2 in. lbs. torque, 15 uuf min. max. at 2-1/2 turns open, 1000 vdcw	918-0032-00
C106	CAPACITOR, VARIABLE, MICA: same as C105	918-0032-00
C107	CAPACITOR, VARIABLE, MICA: same as C105	918-0032-00
C108	CAPACITOR, VARIABLE, MICA: same as C105	918-0032-00
C109	CAPACITOR, VARIABLE, MICA: same as C105	918-0032-00
C110	CAPACITOR, VARIABLE, MICA: same as C105	918-0032-00
C111	CAPACITOR, FIXED, MICA: same as C6	912-2753-00
C112	CAPACITOR, FIXED, CERAMIC: same as C5	913-2142-00
C113	CAPACITOR, FIXED, CERAMIC: same as C13	913-0299-00
C114	CAPACITOR, FIXED, MICA: same as C2	912-2735-00
C115	CAPACITOR, FIXED, CERAMIC: same as C5	913-2142-00
C116	CAPACITOR, VARIABLE, CERAMIC: same as C103	917-1075-00
C117	CAPACITOR, FIXED, MICA: same as C2	912-2735-00
C118	CAPACITOR, FIXED, ELECTROLYTIC: 8 uf -10% +100%, 150 vdcw	183-1357-00
C119	CAPACITOR, FIXED, ELECTROLYTIC: same as C40	183-0787-00
C120	CAPACITOR, FIXED, PAPER: 0.1 uf ±20%, 400 vdcw	931-4552-00
C121	CAPACITOR, FIXED, ELECTROLYTIC: dual section, 40 uf -10% +100%, 450 vdcw	183-0081-00
C122	CAPACITOR, FIXED, ELECTROLYTIC: same as C121	183-0081-00
C123	CAPACITOR, FIXED, PAPER: same as C29	931-4530-00
C124	CAPACITOR, FIXED, ELECTROLYTIC: same as C40	183-0787-00
C125	CAPACITOR, FIXED, ELECTROLYTIC: same as C118	183-1357-00
C126	CAPACITOR, FIXED, ELECTROLYTIC: same as C118	183-1357-00
C127	CAPACITOR, FIXED, ELECTROLYTIC: same as C118	183-1357-00
C128	CAPACITOR, FIXED, PAPER: 0.047 uf ±20%, 300 vdcw	931-4526-00
C129	CAPACITOR, FIXED, ELECTROLYTIC: 30 uf -10% +100%, 350 vdcw; Sprague Electric part no. S74228	183-0788-00
C130	CAPACITOR, FIXED, MICA: same as C11	912-2864-00
C131	CAPACITOR, FIXED, CERAMIC: same as C13	913-0299-00
C132	CAPACITOR, FIXED, CERAMIC: same as C5	913-2142-00
C133	CAPACITOR, FIXED, CERAMIC: 10,000 uuf ±20%, 1000 vdcw	913-3922-00
C134	CAPACITOR, FIXED, CERAMIC: same as C133	913-3922-00
C135	CAPACITOR, FIXED, CERAMIC: same as C133	913-3922-00
C136	CAPACITOR, FIXED, CERAMIC: same as C133	913-3922-00
C137	CAPACITOR, FIXED, CERAMIC: same as C133	913-3922-00
C138	CAPACITOR, FIXED, CERAMIC: same as C133	913-3922-00
C139	CAPACITOR, FIXED, CERAMIC: same as C133	913-3922-00
C140	CAPACITOR, FIXED, CERAMIC: same as C133	913-3922-00
C141	CAPACITOR, FIXED, CERAMIC: same as C133	913-3922-00
C142	CAPACITOR, FIXED, MICA: same as C84	912-2839-00
C143	CAPACITOR, VARIABLE, MICA: same as C105	918-0032-00
CR1	SEMICONDUCTOR DEVICE, DIODE: silicon, 150 vdcw; 30 milliamp dc; Hughes Aircraft part no. 1N328	353-2776-00
CR2	SEMICONDUCTOR DEVICE, DIODE: same as CR1	353-2776-00
CR3	SEMICONDUCTOR DEVICE, DIODE: germanium, hermetically sealed; 30 milliamp nom current; 80 vdcw; Hughes Aircraft Co. part no. 1N67A	353-0147-00
CR4	SEMICONDUCTOR DEVICE, DIODE: silicon, hermetically sealed; Transitron part no. 1N914	353-2906-00
CR5	SEMICONDUCTOR DEVICE, DIODE: same as CR3	353-0147-00
CR6	SEMICONDUCTOR DEVICE, DIODE: same as CR4	353-2906-00
CR7	SEMICONDUCTOR DEVICE, DIODE: same as CR1	353-2776-00
CR8	SEMICONDUCTOR DEVICE, DIODE: same as CR3	353-0147-00
CR9	SEMICONDUCTOR DEVICE, DIODE: same as CR1	353-2776-00
CR10	SEMICONDUCTOR DEVICE, DIODE: same as CR3	353-0147-00
CR11	SEMICONDUCTOR DEVICE, DIODE: same as CR1	353-2776-00
CR12	SEMICONDUCTOR DEVICE, DIODE: same as CR1	353-2776-00
CR13	SEMICONDUCTOR DEVICE, DIODE: same as CR1	353-2776-00
CR14	SEMICONDUCTOR DEVICE, DIODE: same as CR3	353-0147-00
CR15	SEMICONDUCTOR DEVICE, DIODE: same as CR3	353-0147-00
CR16	SEMICONDUCTOR DEVICE, DIODE: same as CR3	353-0147-00
CR17	SEMICONDUCTOR DEVICE, DIODE: same as CR3	353-0147-00
CR18	SEMICONDUCTOR DEVICE, DIODE: same as CR3	353-0147-00
CR19	SEMICONDUCTOR DEVICE, DIODE: same as CR3	353-0147-00
CR20	SEMICONDUCTOR DEVICE, DIODE: same as CR3	353-0147-00
CR21	SEMICONDUCTOR DEVICE, DIODE: same as CR1	353-2776-00
CR22	SEMICONDUCTOR DEVICE, DIODE: same as CR1	353-2776-00

ITEM	DESCRIPTION	COLLINS PART NUMBER
CR23	SEMICONDUCTOR DEVICE, DIODE: same as CR1	353-2776-00
CR24	SEMICONDUCTOR DEVICE, DIODE: same as CR1	353-2776-00
CR25	SEMICONDUCTOR DEVICE, DIODE: same as CR3	353-0147-00
CR26	SEMICONDUCTOR DEVICE, DIODE: same as CR1	353-2776-00
CR27	SEMICONDUCTOR DEVICE, DIODE: same as CR1	353-2776-00
CR28	SEMICONDUCTOR DEVICE, DIODE: silicon, hermetically sealed; JEDEC type 1N724A	353-2747-00
CR29	SEMICONDUCTOR DEVICE, DIODE: same as CR1	353-2776-00
CR30	SEMICONDUCTOR DEVICE, DIODE: same as CR3	353-0147-00
CR31	SEMICONDUCTOR DEVICE, DIODE: same as CR1	353-2776-00
CR32	SEMICONDUCTOR DEVICE, DIODE: same as CR3	353-0147-00
CR33	SEMICONDUCTOR DEVICE, DIODE: same as CR1	353-2776-00
CR34	SEMICONDUCTOR DEVICE, DIODE: same as CR1	353-2776-00
CR35	SEMICONDUCTOR DEVICE, DIODE: silicon, hermetically sealed; Motorola, Inc. part no. 1N1492	353-1661-00
CR36	SEMICONDUCTOR DEVICE, DIODE: same as CR35	353-1661-00
CR37	SEMICONDUCTOR DEVICE, DIODE: same as CR35	353-1661-00
CR38	SEMICONDUCTOR DEVICE, DIODE: same as CR35	353-1661-00
CR39	SEMICONDUCTOR DEVICE, DIODE: same as CR35	353-1661-00
CR40	SEMICONDUCTOR DEVICE, DIODE: same as CR35	353-1661-00
CR41	SEMICONDUCTOR DEVICE, DIODE: same as CR35	353-1661-00
CR42	SEMICONDUCTOR DEVICE, DIODE: same as CR35	353-1661-00
CR43	SEMICONDUCTOR DEVICE, DIODE: same as CR3	353-0147-00
CR44	SEMICONDUCTOR DEVICE, DIODE: same as CR1	353-2776-00
CR45	SEMICONDUCTOR DEVICE, DIODE: same as CR3	353-0147-00
CR46	SEMICONDUCTOR DEVICE, DIODE: same as CR1	353-2776-00
CR47	SEMICONDUCTOR DEVICE, DIODE: same as CR3	353-0147-00
CR48	SEMICONDUCTOR DEVICE, DIODE: same as CR3	353-0147-00
CR49	SEMICONDUCTOR DEVICE, DIODE: same as CR3	353-0147-00
CR50	SEMICONDUCTOR DEVICE, DIODE: same as CR3	353-0147-00
CR51	SEMICONDUCTOR DEVICE, DIODE: same as CR3	353-0147-00
CR52	NOT USED	
CR53	SEMICONDUCTOR DEVICE, DIODE: Pacific Semiconductors type 1N758	353-2723-00
DL1	DELAY LINE: constant distribution, hermetically sealed case, 12 ± 0.2 microseconds delay time, 7500 ohms ±10% impedance, 0 dc current	799-0045-00
DS1	LAMP, INCANDESCENT: miniature bayonet base, 6.3 v, 0.150 amp current, T-3-1/4 bulb; C-212 filament; General Electric part no. 47	262-3240-00
DS2	LAMP, INCANDESCENT: midget flange base, T-1-3/4 clear bulb; 28 v, 0.04 amp, C-2F filament; General Electric part no. 327	262-0179-00
F1	FUSE, CARTRIDGE: glass enclosed, time lag; 2 amp, 125 v	264-0008-00
F2	FUSE, CARTRIDGE: same as F1	264-0008-00
F3	FUSE, CARTRIDGE: same as F1	264-0008-00
F4	FUSE, CARTRIDGE: glass enclosed, time lag; 0.750 amp, 250 v max; 0.75 ohm resistance; Bussman Mfg. Co. part no. MDL 3/4	264-4270-00
H1	BUMPER: rubber w/ imbedded washer insert; 1/4 in. w, 3/4 in. dia; Lavelle Rubber Co. part no. 512-RW	200-0950-00
H2	BUMPER: same as H1	200-0950-00
J1	CONNECTOR, RECEPTACLE, ELECTRICAL: brass, 1 female contact, 1 connector mating end; Industrial Products Co. part no. 87075	357-9183-00
J2	CONNECTOR, RECEPTACLE, ELECTRICAL: same as J1	357-9183-00
J3	JACK, TELEPHONE: one circuit jack for plugs w/ 1/4 in. barrel	358-1040-00
J4	CONNECTOR, RECEPTACLE, ELECTRICAL: 3 wire recessed mtg, male, 10 amp at 250 v ac or dc, 15 amp at 125 v ac or dc; Harvey Hubbell part no. 5278	368-0112-00
J5 thru J9	CONNECTOR, RECEPTACLE, ELECTRICAL: same as J1	357-9183-00
J10	CONNECTOR, RECEPTACLE, ELECTRICAL: flush base, 2 wire, male, polarized; 10 amp, 250 v, 15 amp, 125 v; Harvey Hubbell part no. 7467	368-0134-00
J11	CONNECTOR, RECEPTACLE, ELECTRICAL: 3 wire twist lock, male contact; 10 amp, 250 v, 15 amp, 125 v; Harvey Hubbell, Inc. part no. 7808	368-0135-00
J12	CONNECTOR, RECEPTACLE, ELECTRICAL: 55 male contacts, panel mtg; 7.5 amp; Bendix Aviation (Scintilla Div.) part no. PT02A-22-55P	371-2011-00
J13	JACK, TIP: insulated; for use w/ standard 0.080 in. test probes; white; E. P. Johnson part no. 105-201-200	360-0149-00
J14 thru J33	JACK, TIP: same as J13	360-0149-00
J34	POST, BINDING: insulated w/ banana plug jack, 1000 v, 30 amp, green insulation; Superior Electric Co. part no. DFN 30GNC	372-1065-00

DME Bench Rest Set 578D-1

ITEM	DESCRIPTION	COLLINS PART NUMBER
J35 thru J39	POST, BINDING: same as J34	372-1065-00
L1	COIL, RADIO FREQUENCY: 2000 uh ±5%, 27.5 max dc resistance, 115 ma dc current; Delevan part no. 2500-42	240-2547-00
L2	COIL, RADIO FREQUENCY: 5000 uh ±5%, 46.0 ohms dc resistance; 85 ma dc current; Delevan part no. 2500-62	240-2557-00
L3	COIL, RADIO FREQUENCY: same as L2	240-2557-00
L4	COIL RADIO FREQUENCY: 47 uh ±10%, 1.20 ohm dc resistance, 750 ma dc current rating; Jeffers part no. 10404-28	240-0190-00
L5	COIL, RADIO FREQUENCY: 50 mh, 15.9 ohms, 56 ma dc current; Communications Accessories part no. MP-206-14B	240-0270-00
L6	COIL, RADIO FREQUENCY: 1000 uh ±5%, 16.0 ohm dc resistance, 135 ma dc current; Delevan part no. 2500-28	240-2540-00
L7	COIL, RADIO FREQUENCY: same as L6	240-2540-00
L8	COIL, RADIO FREQUENCY: 10 mh, 35 ohm dc, 126 ma dc current; Communication Accessories part no. MP-206-5-B	240-0261-00
L9	COIL, RADIO FREQUENCY: same as L4	240-0190-00
L10	COIL, RADIO FREQUENCY: 20 mh, 25 ohm dc, 89 ma current; Communication Accessories part no. MP-206-9B	240-0265-00
L11	COIL, RADIO FREQUENCY: same as L6	240-2540-00
L12	COIL, RADIO FREQUENCY: 500 uh ±5%, 11.0 ohm dc resistance, 170 ma dc current; Delevan part no. 2500-14	240-2533-00
L13	COIL, RADIO FREQUENCY: 100 uh ±5%, 4.00 ohm max dc resistance; 260 ma dc current; Delevan part no. 1537-76	240-2516-00
L14	COIL, RADIO FREQUENCY: 220 uh ±5%, 7.20 ohm max dc resistance; 210 ma dc current; Delevan part no. 1537-92	240-2524-00
MP1	COUPLING, SHAFT, RIGID: aluminum, 1/2 in. dia by 5/8 in. lg; 4 holes drilled and tapped 4-48 NF-2B at 90°	547-1941-002
MP2	SHAFT, EXTENSION, POTENTIOMETER, NO. 2: CRES, 1/2 in. dia undercut to 0.125 in. dia, 27/32 in. lg overall	547-1950-002
MP3	SHAFT, EXTENSION, CAPACITOR: CRES, 0.249 in. dia undercut to 0.125 in. dia, 29/32 in. lg overall	547-1954-002
MP4	COUPLING: flexible, insulated, nickel plated; body, brass; Bakelite disc type "C"; 0.250 in. id, 1.094 in. od, 0.672 in. w; Oak Mfg. Co. part no. 6432-032	015-0052-00
MP5	COUPLING: brass, rigid for 1/4 in. shaft, 0.250 in. id, 1/2 in. od, 3/4 in. lg; 2 setscrews; James Millen Mfg. Co. Inc. part no. 39003	015-0257-00
MP6	SHAFT, STRAIGHT: CRES, 0.249 in. dia by 5-1/8 in. lg; chamfer both ends	547-1934-002
MP7	BUSHING AND NUT: brass, thd 3/8 - 32 NEF-2, 3/8 in. lg; 1/2 in. w across flats, 7/16 in. lg overall; P.R. Mallory part no. UB-241	015-0132-00
MP8	COUPLING: same as MP4	015-0052-00
MP9	SHAFT, ECODER, EXTENSION: CRES, 0.249 in. dia by 8-3/16 in. lg	547-1960-002
MP10	DIAL, CONTROL, NO. 1: aluminum, engrave no. 1 only 3/16 in. h on black background; 0.125 in. id, 1.500 in. od, 5/16 in. w; 6 holes spaced 60°	547-1975-003
MP11	DIAL, CONTROL, NO. 2: aluminum, engraved nos. 0 thru 9, 3/16 in. h on black background, 0.125 in. id, 1.500 in. od, 5/16 in. w; 6 holes spaced 60°	547-1976-003
MP12	ARM, DIAL, NO. 1: brass arm 0.562 in. w by approx 1-3/16 in. lg; & felt pad 1/16 in. thk, 1/4 in. w by 9/16 in. lg	547-2156-002
MP13	ARM, DIAL, NO. 2: brass arm 0.312 in. w by approx 1 in. lg overall; & felt pad 7/64 in. w 9/16 in. lg	548-2242-002
MP14	DIAL, CONTROL, NO. 3, ROLLED: aluminum sheet w/ white engraved nos. 0 thru 9 3/16 in. h on 3-1/2 in. dia black background; numbers spaced at 36°; & aluminum hub 25/64 in. w by 1 in. dia	547-1977-003
MP15	SHAFT, DIAL: CRES, 0.1247 in. dia by 3/4 in. lg; chamfer both ends	548-2238-002
MP16	HUB, DIAL: aluminum, 0.125 in. id, 1 in. od, undercut 0.500 in. one end; 0.375 in. other; 25/64 in. w	547-1925-002
MP17	DIAL, TEST SET, PRESSED: aluminum, 0.155 in. id, 1-1/4 in. od w/ 4-40 clinch nut pressed into dial	547-0759-002
MP18	WINDOW, DIAL: clear polystyrene, 1/32 in. thk, irregular shape, 2-1/8 in. by 2-3/8 in. approx	547-1936-002
MP19	PERMANENT MAGNET: cast Alnico 5, fully magnetized, 0.437 in. by 0.562 in. by 1.500 in.	140-0125-00
MP20	COLLAR, SHAFT, GEAR: aluminum, 0.1875 in. id, 7/16 in. od, 7/32 in. w; 4 holes drilled & tapped 2-56 NC-2B at 90°	547-1937-002
MP21	GEAR, SPUR, DIAL: aluminum, 86 teeth, pressure angle 20, diametral pitch 64, 0.1250 in. id, 1.374 in. od	547-1927-002
MP22	SHAFT, DIAL: CRES, 0.1247 in. dia by 3/4 in. lg; chamfer both ends	548-2238-002
MP23	COLLAR, SHAFT, DIAL: aluminum, 0.1875 in. id, 0.437 in. od, 1/4 in. w; 4 holes dipped & tapped 2-56 NC-2B at 90°	547-1946-002
MP24	GEAR, SPUR, DIAL: same as MP21	547-1927-002
O1	KNOB, POINTER, NO. 35: setscrew type, black phenolic w/ aluminum insert; 29/32 in. h by 1-7/16 in. w	544-0781-004
O2	KNOB, POINTER, NO. 35: same as O1	544-0781-004
O3	KNOB, POINTER, NO. 25: setscrew type; black phenolic w/ aluminum insert; approx 1-3/32 in. w by 3/4 in. h	544-0779-004
O4	KNOB: black phenolic w/ 6 flutes, aluminum insert w/ molded diamond knurl; 27/32 in. h by 1.500 in. dia; includes phenolic skirt	546-1293-003
O5 thru O11	KNOB: same as O4	546-1293-004
R1	RESISTOR, FIXED, COMPOSITION: 10,000 ohms ±10%, 1/2 w	745-1394-00
R2	RESISTOR, FIXED, COMPOSITION: 1000 ohms ±10%, 1/2 w	745-1352-00
R3	RESISTOR, FIXED, COMPOSITION: 0.22 megohm ±10%, 1/2 w	745-1450-00
R4	RESISTOR, FIXED, COMPOSITION: 22,000 ohms ±10%, 1/2 w	745-1408-00
R5	RESISTOR, FIXED, COMPOSITION: 18,000 ohms ±10%, 1/2 w	745-1405-00
R6	RESISTOR, FIXED, COMPOSITION: 68,000 ohms ±10%, 1/2 w	745-1429-00
R7	RESISTOR, FIXED, COMPOSITION: 120 ohms ±10%, 1/2 w	745-1314-00
R8	RESISTOR, FIXED, COMPOSITION: 6800 ohms ±10%, 1/2 w	745-1387-00
R9	RESISTOR, FIXED, COMPOSITION: 0.47 megohm ±10%, 1/2 w	745-1464-00
R10	RESISTOR, FIXED, COMPOSITION: same as R7	745-1314-00
R11	RESISTOR, FIXED, COMPOSITION: 8200 ohms ±10%, 1/2 w	745-1391-00
R12	RESISTOR, FIXED, COMPOSITION: same as R11	745-1391-00
R13	RESISTOR, FIXED, COMPOSITION: 33,000 ohms ±10%, 1/2 w	745-1415-00
R14	RESISTOR, FIXED, COMPOSITION: same as R13	745-1415-00
R15	RESISTOR, FIXED, COMPOSITION: 0.10 megohms ±10%, 1/2 w	745-1436-00
R16	RESISTOR, FIXED, COMPOSITION: same as R1	745-1394-00
R17	RESISTOR, FIXED, COMPOSITION: same as R2	745-1352-00
R18	RESISTOR, FIXED, COMPOSITION: 12,000 ohms ±10%, 1/2 w	745-1398-00
R19	RESISTOR, FIXED, COMPOSITION: 56 ohms ±10%, 1/2 w	745-1300-00
R20	RESISTOR, FIXED, COMPOSITION: 150 ohms ±10%, 1/2 w	745-1317-00
R21	RESISTOR, FIXED, COMPOSITION: 27,000 ohms ±10%, 1/2 w	745-1412-00
R22	RESISTOR, FIXED, COMPOSITION: 0.33 megohms ±10%, 1/2 w	745-1457-00
R23	RESISTOR, FIXED, COMPOSITION: 47,000 ohms ±10%, 1/2 w	745-1422-00
R24	RESISTOR, FIXED, COMPOSITION: same as R6	745-1429-00
R25	RESISTOR, FIXED, COMPOSITION: same as R2	745-1352-00
R26	RESISTOR, FIXED, COMPOSITION: same as R8	745-1387-00
R27	RESISTOR, FIXED, COMPOSITION: 4700 ohms ±10%, 1/2 w	745-1380-00
R28	RESISTOR, FIXED, COMPOSITION: same as R15	745-1436-00
R29	RESISTOR, FIXED, COMPOSITION: 15,000 ohms ±10%, 1/2 w	745-1401-00
R30	RESISTOR, FIXED, COMPOSITION: same as R15	745-1436-00
R31	RESISTOR, FIXED, COMPOSITION: same as R7	745-1314-00
R32	RESISTOR, FIXED, COMPOSITION: same as R15	745-1436-00
R33	RESISTOR, FIXED, COMPOSITION: same as R1	745-1394-00
R34	RESISTOR, FIXED, COMPOSITION: same as R8	745-1387-00
R35	RESISTOR, FIXED, COMPOSITION: same as R2	745-1352-00
R36	RESISTOR, FIXED, COMPOSITION: same as R4	745-1408-00

ITEM	DESCRIPTION	COLLINS PART NUMBER
R37	RESISTOR, FIXED, COMPOSITION: 3.3 megohms ±10%, 1/2 w	745-1499-00
R38	RESISTOR, FIXED, FILM: 261,000 ohms ±1%, 1/4 w	705-7212-00
R39	RESISTOR, FIXED, FILM: 56,000 ohms ±1%, 1/4 w	705-7180-00
R40	RESISTOR, FIXED, FILM: 26,100 ohms ±10%, 1/4 w	705-7164-00
R41	RESISTOR, FIXED, COMPOSITION: same as R3	745-1450-00
R42	RESISTOR, FIXED, COMPOSITION: same as R3	745-1450-00
R43	RESISTOR, FIXED, COMPOSITION: 2.2 megohms ±10%, 1/2 w	745-1492-00
R44	RESISTOR, FIXED, COMPOSITION: 10,000 ohms ±10%, 2 w	745-5694-00
R45	RESISTOR, FIXED, FILM: 23,700 ohms ±1%, 1/4 w	705-7162-00
R46	RESISTOR, VARIABLE: wirewound; 10,000 ohms ±10%, 2 w	750-0504-00
R47	RESISTOR, FIXED, COMPOSITION: same as R9	745-1464-00
R48	RESISTOR, FIXED, COMPOSITION: 1500 ohms ±10%, 1/2 w	745-1359-00
R49	RESISTOR, FIXED, COMPOSITION: same as R11	745-1391-00
R50	RESISTOR, FIXED, COMPOSITION: same as R15	745-1436-00
R51	RESISTOR, FIXED, COMPOSITION: same as R15	745-1436-00
R52	RESISTOR, FIXED, COMPOSITION: same as R15	745-1436-00
R53	RESISTOR, FIXED, COMPOSITION: 39,000 ohms ±10%, 1/2 w	745-1419-00
R54	RESISTOR, FIXED, COMPOSITION: 390 ohms ±10%, 1/2 w	745-1335-00
R55	RESISTOR, FIXED, COMPOSITION: same as R48	745-1359-00
R56	RESISTOR, FIXED, COMPOSITION: same as R53	745-1419-00
R57	RESISTOR, FIXED, COMPOSITION: 10,000 ohms ±10%, 1/2 w	745-3394-00
R58	RESISTOR, FIXED, COMPOSITION: same as R13	745-1415-00
R59	RESISTOR, FIXED, COMPOSITION: same as R1	745-1394-00
R60	RESISTOR, FIXED, COMPOSITION: 0.10 megohm ±10%, 1/2 w	745-3436-00
R61	RESISTOR, FIXED, COMPOSITION: same as R29	745-1401-00
R62	RESISTOR, FIXED, COMPOSITION: 1.0 megohm ±10%, 1/2 w	745-1478-00
R63	RESISTOR, FIXED, COMPOSITION: same as R3	745-1450-00
R64	RESISTOR, VARIABLE, COMPOSITION: 250,000 ohms ±20%, 2 w	380-2761-00
R65	RESISTOR, FIXED, WIREWOUND: 200,000 ohms ±1%, 0.25 w	748-7510-00
R66	RESISTOR, FIXED, COMPOSITION: same as R54	745-1335-00
R67	RESISTOR, FIXED, COMPOSITION: same as R27	745-1380-00
R68	RESISTOR, FIXED, COMPOSITION: same as R3	745-1450-00
R69	RESISTOR, FIXED, COMPOSITION: 22,000 ohms ±10%, 1/2 w	745-5708-00
R70	RESISTOR, FIXED, COMPOSITION: same as R69	745-5708-00
R71	RESISTOR, FIXED, FILM: 383,000 ohms ±1%, 1/4 w	705-7220-00
R72	RESISTOR, VARIABLE, COMPOSITION: 500,000 ohms ±20%, 1/2 w	380-2912-00
R73	RESISTOR, FIXED, COMPOSITION: same as R13	745-1415-00
R74	RESISTOR, FIXED, COMPOSITION same as R4	745-1408-00
R75	RESISTOR, FIXED, COMPOSITION: 1800 ohms ±10%, 1/2 w	745-1363-00
R76	RESISTOR, FIXED, COMPOSITION: 0.27 megohm ±10%, 1/2 w	745-1454-00
R77	RESISTOR, FIXED, COMPOSITION: same as R76	745-1454-00
R78	RESISTOR, FIXED, COMPOSITION: same as R5	745-1405-00
R79	RESISTOR, FIXED, COMPOSITION: same as R76	745-1454-00
R80	RESISTOR, FIXED, COMPOSITION: same as R23	745-1422-00
R81	RESISTOR, FIXED, COMPOSITION: same as R57	745-3394-00
R82	RESISTOR, FIXED, COMPOSITION: 18,000 ohms ±10%, 2 w	745-5705-00
R83	RESISTOR, FIXED, FILM: 140 ohms ±1%, 1/2 w	705-7555-00
R84	RESISTOR, FIXED, COMPOSITION: 4700 ohms ±10%, 1/2 w	745-3380-00
R85	RESISTOR, FIXED, COMPOSITION: 27,000 ohms ±10%, 1 w	745-3412-00
R86	RESISTOR, FIXED, FILM: 261,000 ohms ±1%, 1/2 w	705-7712-00
R87	RESISTOR, FIXED, FILM: 10,000 ohms ±1%, 1/4 w	705-7144-00
R88	RESISTOR, FIXED, COMPOSITION: same as R15	745-1436-00
R89	RESISTOR, FIXED, FILM: 56,200 ohms ±1%, 1/2 w	705-7680-00
R90	RESISTOR, FIXED, FILM: 8,250 ohms ±1%, 1/4 w	705-7140-00
R91	RESISTOR, FIXED, FILM: 110,000 ohms ±1%, 1/4 w	705-7194-00
R92	RESISTOR, FIXED, FILM: 100,000 ohms ±1%, 1/4 w	705-7192-00
R93	RESISTOR, FIXED, COMPOSITION: same as R29	745-1401-00
R94	RESISTOR, FIXED, COMPOSITION: 0.68 megohm ±10%, 1/2 w	745-1471-00
R95	RESISTOR, FIXED, FILM: same as R83	705-7555-00
R96	NOT USED	
R97	RESISTOR, FIXED, COMPOSITION: same as R15	745-1436-00
R98	RESISTOR, FIXED, COMPOSITION: same as R27	745-1380-00
R99	RESISTOR, FIXED, COMPOSITION: 5600 ohms ±10%, 1/2 w	745-1384-00
R100	RESISTOR, FIXED, FILM: 13,300 ohms ±1%, 1/4 w	705-7150-00
R101	RESISTOR, VARIABLE, COMPOSITION: 2500 ohms ±20%, 2 w	380-2755-00
R102	RESISTOR, FIXED, WIREWOUND: 7,680 ohms ±1%, 0.15 w	748-7011-00
R103	RESISTOR, FIXED, FILM: 61,900 ohms ±1%, 1/4 w	705-7182-00
R104	RESISTOR, FIXED, WIREWOUND: 3,010 ohms ±1%, 0.15 w	748-7009-00
R105	RESISTOR, FIXED, WIREWOUND: same as R104	748-7009-00
R106	RESISTOR, FIXED, WIREWOUND: same as R104	748-7009-00
R107	RESISTOR, FIXED, WIREWOUND: 3,090 ohms ±1%, 0.15 w	748-7010-00
R108 thru R113	RESISTOR, FIXED, WIREWOUND: same as R107	748-7010-00
R114	RESISTOR, FIXED, WIREWOUND: 11,800 ohms ±1%, 0.15 w	748-7012-00
R115	RESISTOR, FIXED, FILM: 4,640 ohms ±1%, 1/4 w	705-7128-00
R116	RESISTOR, FIXED, FILM: 46,400 ohms ±1%, 1/4 w	705-7176-00
R117	RESISTOR, FIXED, FILM: 82,500 ohms ±1%, 1/4 w	705-7188-00
R118	RESISTOR, VARIABLE: wirewound; 50,000 ohms ±3%, 5 w	381-1439-00
R119	RESISTOR, VARIABLE: wirewound; dual resistor, both sections 500 ohms ±10%, 4.0 w	750-4578-00
R120	RESISTOR, VARIABLE: same as R119	750-4578-00
R121	RESISTOR, FIXED, COMPOSITION: same as R11	745-1391-00
R122	RESISTOR, FIXED, COMPOSITION: same as R43	745-1492-00
R123	RESISTOR, FIXED, COMPOSITION: same as R1	745-1394-00
R124	RESISTOR, VARIABLE, COMPOSITION: 50,000 ohms ±20%, 1/2 w	380-2909-00
R125	RESISTOR, FIXED, COMPOSITION: same as R2	745-1352-00
R126	RESISTOR, FIXED, COMPOSITION: same as R1	745-1394-00
R127	RESISTOR, FIXED, COMPOSITION: 330 ohms ±10%, 1/2 w	745-1331-00
R128	RESISTOR, FIXED, FILM: 82,500 ohms ±1%, 1/2 w	705-7688-00
R129	RESISTOR, VARIABLE, COMPOSITION: 50,000 ohms ±20%, 2 w	380-2759-00
R130	RESISTOR, FIXED, COMPOSITION: 1.2 megohms ±10%, 1/2 w	745-1482-00
R131	RESISTOR, FIXED, COMPOSITION: same as R11	745-1391-00
R132	RESISTOR, FIXED, COMPOSITION: same as R23	745-1422-00
R133	RESISTOR, FIXED, COMPOSITION: same as R27	745-1380-00
R134	RESISTOR, FIXED, COMPOSITION: 33,000 ohms ±10%, 2 w	745-5715-00
R135	RESISTOR, FIXED, COMPOSITION: same as R23	745-1422-00
R136	RESISTOR, FIXED, COMPOSITION: same as R53	745-1419-00
R137	RESISTOR, FIXED, COMPOSITION: same as R29	745-1401-00
R138	RESISTOR, FIXED, COMPOSITION: same as R29	745-1401-00
R139	RESISTOR, FIXED, COMPOSITION: 0.56 megohm ±10%, 1/2 w	745-1468-00
R140	RESISTOR, FIXED, COMPOSITION: same as R27	745-1380-00
R141	RESISTOR, FIXED, COMPOSITION: same as R11	745-1391-00
R142	RESISTOR, FIXED, COMPOSITION: same as R3	745-1450-00
R143	RESISTOR, FIXED, COMPOSITION: same as R8	745-1387-00
R144	NOT USED	
R145	RESISTOR, FIXED, COMPOSITION: same as R127	745-1331-00
R146	RESISTOR, FIXED, COMPOSITION: same as R27	745-1380-00
R147	RESISTOR, FIXED, COMPOSITION: 820 ohms ±10%, 1/2 w	745-1349-00
R148	RESISTOR, FIXED, COMPOSITION: same as R20	745-1317-00
R149	RESISTOR, FIXED, COMPOSITION: same as R3	745-1450-00
R150	RESISTOR, FIXED, COMPOSITION: same as R4	745-1408-00
R151	RESISTOR, FIXED, COMPOSITION: same as R43	745-1492-00
R152	RESISTOR, FIXED, COMPOSITION: same as R2	745-1352-00
R153	RESISTOR, FIXED, COMPOSITION: same as R134	745-5715-00
R154	RESISTOR, FIXED, FILM: 121,000 ohms ±1%, 1/4 w	705-7196-00
R155	RESISTOR, FIXED, FILM: 196,000 ohms ±1%, 1/4 w	705-7206-00
R156	RESISTOR, VARIABLE, COMPOSITION: same as R124	380-2909-00
R157	RESISTOR, FIXED, FILM: 464,000 ohms ±1%, 1/4 w	705-7224-00

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ITEM	DESCRIPTION	COLLINS PART NUMBER
R158	RESISTOR, FIXED, COMPOSITION: same as R22	745-1457-00
R159	RESISTOR, FIXED, COMPOSITION: 1,000,000 ohms ±1%, 1/4 w	705-7240-00
R160	RESISTOR, FIXED, COMPOSITION: same as R9	745-1464-00
R161	RESISTOR, FIXED, COMPOSITION: same as R62	745-1478-00
R162	RESISTOR, FIXED, COMPOSITION: same as R37	745-1499-00
R163	RESISTOR, FIXED, COMPOSITION: 8200 ohms ±10%, 1 w	745-3391-00
R164	RESISTOR, FIXED, FILM: 110,000 ohms ±1%, 1/4 w	705-7194-00
R165	RESISTOR, VARIABLE, COMPOSITION: 10,000 ohms ±20%, 1/2 w	380-2907-00
R166	RESISTOR, FIXED, FILM: same as R103	705-7182-00
R167	RESISTOR, FIXED, FILM: 237,000 ohms ±1%, 1/4 w	705-7210-00
R168	RESISTOR, VARIABLE, COMPOSITION: same as R124	380-2909-00
R169	RESISTOR, FIXED, COMPOSITION: same as R15	745-1436-00
R170	RESISTOR, FIXED, COMPOSITION: 180 ohms ±10%, 1/2 w	745-1321-00
R171	RESISTOR, FIXED, COMPOSITION: same as R27	745-1380-00
R172	RESISTOR, FIXED, COMPOSITION: same as R1	745-1394-00
R173	RESISTOR, FIXED, COMPOSITION: 22 ohms ±10%, 1/2 w	745-1282-00
R174	NOT USED	
R175	RESISTOR, VARIABLE, COMPOSITION: 250 ohms ±20%, 1/2 w	380-2802-00
R176	RESISTOR, FIXED, COMPOSITION: 3900 ohms ±10%, 1/2 w	745-1377-00
R177	RESISTOR, FIXED, COMPOSITION: same as R170	745-1321-00
R178	RESISTOR, FIXED, COMPOSITION: same as R3	745-1450-00
R179	RESISTOR, FIXED, COMPOSITION: same as R3	745-1450-00
R180	RESISTOR, FIXED, COMPOSITION: same as R1	745-1394-00
R181	RESISTOR, FIXED, COMPOSITION: same as R4	745-1408-00
R182	RESISTOR, FIXED, COMPOSITION: same as R27	745-1380-00
R183	RESISTOR, FIXED, COMPOSITION: same as R2	745-1352-00
R184	RESISTOR, FIXED, COMPOSITION: same as R29	745-1401-00
R185	RESISTOR, FIXED, COMPOSITION: same as R4	745-1408-00
R186	RESISTOR, FIXED, COMPOSITION: same as R13	745-1415-00
R187	RESISTOR, FIXED, COMPOSITION: same as R15	745-1436-00
R188	RESISTOR, FIXED, COMPOSITION: same as R7	745-1314-00
R189	RESISTOR, FIXED, COMPOSITION: same as R23	745-1422-00
R190	RESISTOR, FIXED, COMPOSITION: same as R8	745-1387-00
R191	RESISTOR, FIXED, COMPOSITION: same as R127	745-1331-00
R192	RESISTOR, FIXED, COMPOSITION: same as R2	745-1352-00
R193	RESISTOR, FIXED, COMPOSITION: same as R15	745-1436-00
R194	RESISTOR, FIXED, COMPOSITION: same as R1	745-1394-00
R195	RESISTOR, FIXED, FILM: same as R87	705-7144-00
R196	RESISTOR, FIXED, COMPOSITION: same as R2	745-1352-00
R197	RESISTOR, FIXED, COMPOSITION: 6800 ohms ±10%, 2 w	745-5687-00
R198	RESISTOR, FIXED, FILM: 562,000 ohms ±1%, 1/2 w	705-7728-00
R199	RESISTOR, FIXED, COMPOSITION: same as R44	745-5694-00
R200	RESISTOR, FIXED, FILM: 215,000 ohms ±1%, 1/4 w	705-7208-00
R201	RESISTOR, FIXED, COMPOSITION: same as R15	745-1436-00
R202	RESISTOR, FIXED, COMPOSITION: 470 ohms ±10%, 1/2 w	745-1338-00
R203	RESISTOR, FIXED, COMPOSITION: same as R27	745-1380-00
R204	RESISTOR, FIXED, COMPOSITION: same as R202	745-1338-00
R205	RESISTOR, VARIABLE, COMPOSITION: same as R165	380-2907-00
R206	RESISTOR, FIXED, COMPOSITION: 0.27 megohm ±5%, 1/2 w	745-1453-00
R207	RESISTOR, VARIABLE, COMPOSITION: same as R124	380-2909-00
R208	RESISTOR, FIXED, COMPOSITION: 0.10 megohm ±5%, 1/2 w	745-1435-00
R209	NOT USED	
R210	RESISTOR, FIXED, COMPOSITION: same as R76	745-1454-00
R211	RESISTOR, FIXED, COMPOSITION: 56,000 ohms ±10%, 1/2 w	745-1426-00
R212	RESISTOR, FIXED, COMPOSITION: 1.5 megohm ±10% 1/2 w	745-1485-00
R213	RESISTOR, FIXED, COMPOSITION: 68,000 ohms ±10%, 1/2 w	745-3429-00
R214	RESISTOR, FIXED, COMPOSITION: same as R213	745-3429-00
R215	RESISTOR, FIXED, COMPOSITION: 0.15 megohm ±5%, 1/2 w	745-1442-00
R216	RESISTOR, VARIABLE, COMPOSITION: 25,000 ohms ±20%, 1/2 w	380-2908-00
R217	RESISTOR, FIXED, COMPOSITION: same as R208	745-1435-00
R218	RESISTOR, FIXED, COMPOSITION: same as R212	745-1485-00
R219	RESISTOR, FIXED, COMPOSITION: same as R3	745-1450-00
R220	RESISTOR, FIXED, COMPOSITION: same as R53	745-1419-00
R221	RESISTOR, FIXED, COMPOSITION: 5000 ohms ±5%, 11 w	746-6094-00
R222	RESISTOR, FIXED, FILM: 75,000 ohms ±1%, 1/4 w	705-7186-00
R223	RESISTOR, FIXED, COMPOSITION: 11,000 ohms ±1%, 1/4 w	705-7146-00
R224	RESISTOR, FIXED, FILM: 5,110 ohms ±1%, 1/4 w	705-7130-00
R225	RESISTOR, FIXED, FILM: same as R87	705-7144-00
R226	RESISTOR, FIXED, WIREWOUND: 185 ohms ±1%, 3 w	747-9336-00
R227	RESISTOR, FIXED, WIREWOUND: 200 ohms ±1%, 3 w	747-9337-00
R228 thru R238	RESISTOR, FIXED, WIREWOUND: same as R227	747-9337-00
R239	RESISTOR, FIXED, WIREWOUND: same as R226	747-9336-00
R240	RESISTOR, FIXED, WIREWOUND: 111 ohms ±1%, 3 w	747-9334-00
R241	RESISTOR, FIXED, WIREWOUND: 250 ohms ±1%, 3 w	747-9335-00
R242 thru R249	RESISTOR, FIXED, WIREWOUND: same as R241	747-9335-00
R250	RESISTOR, FIXED, WIREWOUND: same as R240	747-9334-00
R251	RESISTOR, FIXED, COMPOSITION: same as R9	745-1464-00
R252	RESISTOR, FIXED, COMPOSITION: same as R9	745-1464-00
R253	RESISTOR, FIXED, COMPOSITION: same as R23	745-1422-00
R254	RESISTOR, FIXED, COMPOSITION: same as R23	745-1422-00
R255	RESISTOR, FIXED, COMPOSITION: same as R54	745-1335-00
R256	RESISTOR, FIXED, COMPOSITION: same as R3	745-1450-00
R257	RESISTOR, FIXED, COMPOSITION: 100 ohms ±10%, 1/2 w	745-1310-00
R258	RESISTOR, FIXED, COMPOSITION: 270 ohms ±10%, 1/2 w	745-1328-00
R259	RESISTOR, VARIABLE, COMPOSITION: same as R72	380-2912-00
R260	RESISTOR, FIXED, COMPOSITION: same as R76	745-1454-00
R261	RESISTOR, FIXED, FILM: 162,000 ohms ±1%, 1/4 w	705-7202-00
R262	RESISTOR, FIXED, FILM: same as R39	705-7180-00
R263	RESISTOR, FIXED, FILM: 31,600 ohms ±1%, 1/4 w	705-7168-00
R264	RESISTOR, FIXED, FILM: 26,100 ohms ±1%, 1/4 w	705-7164-00
R265	RESISTOR, FIXED, FILM: 23,700 ohms ±1%, 1/4 w	705-7162-00
R266	RESISTOR, FIXED, FILM: 14,700 ohms ±1%, 1/4 w	705-7152-00
R267	RESISTOR, FIXED, FILM: 13,300 ohms ±1%, 1/4 w	705-7150-00
R268	RESISTOR, FIXED, FILM: 10,000 ohms ±1%, 1/4 w	705-7144-00
*R269	RESISTOR, FIXED, FILM: 1,960 ohms ±1%, 1/4 w	705-7110-00
*R269	RESISTOR, FIXED, FILM: 2,150 ohms ±1%, 1/4 w	705-7112-00
*R269	RESISTOR, FIXED, FILM: 2,370 ohms ±1%, 1/4 w	705-7114-00
*R269	RESISTOR, FIXED, FILM: 2,610 ohms ±1%, 1/4 w	705-7116-00
*R269	RESISTOR, FIXED, FILM: 2,870 ohms ±1%, 1/4 w	705-7118-00
*R269	RESISTOR, FIXED, FILM: 3,160 ohms ±1%, 1/4 w	705-7120-00
R270	RESISTOR, FIXED, COMPOSITION: 1.5 megohm ±10%, 1/2 w	745-1485-00
S1	SWITCH, ROTARY: 1 circuit, 1 pole, 2 position, 1 section; 1 moving, 3 fixed contacts; Oak Mfg. Co. part no. 210786-H1	259-1321-00
S2	SWITCH, ROTARY: 1 circuit, 1 pole, 3 position, 1 section; 1 moving, 4 fixed contacts; Oak Mfg. Co. part no. 212205-N1	259-1328-00
S3	NOT USED	
S4	SWITCH, ROTARY: 7 circuit, 7 pole, 15 position, 4 section; 8 moving, 46 fixed contacts; Oak Mfg. Co. part no. 210780-RK4	259-1322-00
S5	SWITCH, ROTARY: 4 circuit, 4 pole, 5 position, 2 section; 4 moving, 24 fixed contacts; Oak Mfg. Co. part no. 210787-N2	259-1323-00
S6	SWITCH, ROTARY: 2 circuit, 2 pole, 10 position, 2 section; 2 moving, 17 fixed contacts; Oak Mfg. Co. part no. 209974-A2	259-1316-00

*Chosen per operational requirement.

DME Bench Test Set 578D-1

ITEM	DESCRIPTION	COLLINS PART NUMBER
S7	SWITCH, ROTARY: 4 circuit, 4 pole, 4 position, 5 section; 2 moving, 10 fixed contacts; Oak Mfg. Co. part no. 209975-A5	259-1326-00
S8	SWITCH, ROTARY: 4 circuit, 4 pole, 3 position, 2 section; 4 moving, 16 fixed contacts; Oak Mfg. Co. part no. 210784-H2	259-1325-00
S9	SWITCH, ROTARY: same as S1	259-1321-00
S10	SWITCH, ROTARY: 1 circuit, 1 pole, 13 position, 2 section; 1 moving, 14 fixed contacts; Oak Mfg. Co. part no. 210781-RK2	259-1319-00
S11	SWITCH, ROTARY: 1 circuit, 1 pole, 10 position, 2 section; 1 moving, 11 fixed contacts; Oak Mfg. Co. part no. 210783-N2	259-1324-00
S12	SWITCH, TOGGLE: dpst; 3 position; 250 v dc, 0.5 amp; 220 v ac, 60 cps, 6 amp; Arrow-Hart Hegeman part no. 35059-J	266-5003-00
T1	TRANSFORMER, PULSE: blocking oscillator on 250 v plate supply; pulse width of 1.0 microsecond; Polyphase Inst. Co. part no. PIC-M841	664-8013-00
T2	TRANSFORMER, PULSE: sine wave comparator circuit w/ 45 kc input frequency; Polyphase Inst. Co. part no. PIC-M87	664-8012-00
T3	TRANSFORMER, PULSE: blocking oscillator on 250 v plate supply w/ 0.2 microsecond output pulse width; Polyphase Inst. Co. part no. PIC-M821	664-8014-00
T4	TRANSFORMER, PULSE: same as T1	664-8013-00
T5	TRANSFORMER, PULSE: blocking oscillator type, 250 v plate supply; 0.5 microsecond pulse width; Polyphase Inst. Co. part no. PIC-M831	664-8011-00
T6	TRANSFORMER, PULSE: same as T1	664-8013-00
T7	TRANSFORMER, PULSE: 1.0 usec input pulse, 20.0 usec output pulse; 7 pins; encapsulated	664-8010-00
T8	TRANSFORMER, PULSE: same as T3	664-8014-00
T9	TRANSFORMER, POWER, STEP-UP AND STEP-DOWN: 115 v, 220 v, 230 v, 6.3 v, 6.3 v, CT; 50 to 500 cps; continuous duty cycle; Ballastran Corp. part no. BC-3076	662-0520-00
V1	ELECTRON TUBE: twin triode; RCA type 12AU7	255-0199-00
V2	ELECTRON TUBE: twin triode; RCA type 12AT7	255-0205-00
V3	ELECTRON TUBE: same as V2	255-0205-00
V4	ELECTRON TUBE: same as V2	255-0205-00
V5	ELECTRON TUBE: same as V1	255-0199-00
V6	ELECTRON TUBE: same as V1	255-0199-00
V7	ELECTRON TUBE: pentode; RCA type 6AU6	255-0202-00
V8	ELECTRON TUBE: same as V2	255-0205-00
V9	ELECTRON TUBE: same as V2	255-0205-00
V10	ELECTRON TUBE: pentode; RCA type 6AS6	255-0200-00
V11	ELECTRON TUBE: same as V2	255-0205-00
V12	ELECTRON TUBE: same as V10	255-0200-00
V13	ELECTRON TUBE: same as V1	255-0199-00
V14	ELECTRON TUBE: same as V2	255-0205-00
V15	ELECTRON TUBE: same as V1	255-0199-00
V16	ELECTRON TUBE: same as V1	255-0199-00
V17	ELECTRON TUBE: same as V1	255-0199-00
V18	ELECTRON TUBE: twin triode; Tung-Sol type 5687	255-0224-00
V19	ELECTRON TUBE: same as V1	255-0199-00
V20	ELECTRON TUBE: same as V1	255-0199-00
V21	ELECTRON TUBE: same as V2	255-0205-00
V22	ELECTRON TUBE: same as V2	255-0205-00
V23	ELECTRON TUBE: same as V18	255-0224-00
V24	ELECTRON TUBE: twin triode; RCA type 6080	255-0212-00
V25	ELECTRON TUBE: same as V7	255-0202-00
V26	ELECTRON TUBE: same as V7	255-0202-00
V27	ELECTRON TUBE: voltage regulator; RCA type OB2	257-0058-00
XDS1	LAMPHOLDER: for u/w miniature bayonet base type T-3-1/4 lamp; Dialight part no. 857B-2	262-0919-00
XDS2	LIGHT, INDICATOR: panel mtd, grounded miniature, brass holder; green nylon identifier	262-0570-00
XF1	FUSEHOLDER: extractor post type w/ hole in knob for u/w 1-1/4 by 1/4 fuses; Bussman Fuse Co. part no. HKP-HJR	265-1019-00
XF2 thru XF4	FUSEHOLDER: same as XF1	265-1019-00
XV1	SOCKET, ELECTRON TUBE: 9 contact top mtg, miniature w/ shield base, phenolic insulation; Cinch Mfg. Co. part no. TS103P01	220-1103-00
XV2 thru XV6	SOCKET, ELECTRON TUBE: same as XV1	220-1103-00
XV7	SOCKET, ELECTRON TUBE: 7-contact top mtg, miniature, phenolic insulation; Cinch Mfg. Co. part no. TS102P01	220-1111-00
XV8	SOCKET, ELECTRON TUBE: same as XV1	220-1103-00
XV9	SOCKET, ELECTRON TUBE: same as XV1	220-1103-00
XV10	SOCKET, ELECTRON TUBE: same as XV7	220-1111-00
XV11	SOCKET, ELECTRON TUBE: same as XV1	220-1103-00
XV12	SOCKET, ELECTRON TUBE: same as XV7	220-1111-00
XV13 thru XV23	SOCKET, ELECTRON TUBE: same as XV1	220-1103-00
XV24	SOCKET, ELECTRON TUBE: 8 prong octal w/ mtg plate; phenolic insulation; American Phenolic part no. 88-8TM	220-1005-00
XV25	SOCKET, ELECTRON TUBE: same as XV7	220-1111-00
XV26	SOCKET, ELECTRON TUBE: same as XV7	220-1111-00
XV27	SOCKET, ELECTRON TUBE: same as XV7	220-1111-00
XY1	SOCKET, CRYSTAL: for u/w HC-6/U type crystal holder; H.H. Eby, Inc. part no. 8879	292-0082-00
XY2	SOCKET, CRYSTAL: same as XY1	292-0082-00
Y1	CRYSTAL UNIT, QUARTZ: 89.903 KC	290-4671-00
Y2	CRYSTAL UNIT, QUARTZ: 98.48 KC	290-4672-00
Z1	FILTER, BANDPASS: 44.95 KC ±5% at +25°C; 10 ohms dc resistance, 60 v ac; solder-type terminals; hermetically sealed; Ballastran part no. BC-3087	673-0753-00
	CABLE ASSEMBLY SET, ELECTRICAL	547-2034-00
W1	CABLE ASSEMBLY, SPECIAL PURPOSE, ELECTRICAL: c/o 1 connector w/ 32 contacts and one w/ 55 contacts, aluminum handle and bracket, 8 ft. cable	547-2028-004
W2	CABLE ASSEMBLY, SPECIAL PURPOSE, NO. 1: 2 type 260B/U plug connectors w/ 6.1 ft RG62A/U cable & 2 red cable markers	547-2006-003
W3	CABLE ASSEMBLY, SPECIAL PURPOSE, NO. 2: 2 type 260B/U plug connectors w/ 6.1 ft RG62A/U cable; two green cable markers	547-2007-003
W4	CABLE ASSEMBLY, SPECIAL PURPOSE, NO. 3: 2 type 260B/U plug connectors w/ 6.1 ft RG62A/U cable; two orange cable markers	547-2008-003
W5	CABLE ASSEMBLY, SPECIAL PURPOSE: NO. 4: 2 type 260B/U plug connectors w/ 6.1 ft RG62A/U cable; two tan cable markers	547-2009-003
W6	CABLE ASSEMBLY, SPECIAL PURPOSE: NO. 5: 2 type 260B/U plug connectors w/ 6.1 ft RG62A/U cable; two silver cable markers	547-2010-003
W7	CABLE ASSEMBLY, SPECIAL PURPOSE: NO. 6: 2 type 260B/U plug connectors w/ 6.1 ft RG62A/U cable; two blue cable markers	547-2011-003
W8	CABLE ASSEMBLY, SPECIAL PURPOSE: NO. 7: 2 type 260B/U plug connectors w/ 2 ft RG62A/U cable; two white cable markers	547-2012-003
W9	CABLE ASSEMBLY, SPECIAL PURPOSE, NO. 8: 2 type 260B/U plug connectors w/ 2 ft RG62A/U cable; two yellow cable markers	547-2013-003
W10	CABLE ASSEMBLY, POWER, ELECTRICAL: three conductor, type SJ cord w/ round male and female connectors; 6 ft. lg w/ nickel gray cable marker	426-5041-00
	CONNECTOR, PLUG, ELECTRICAL: 3 female contacts, cable connected; 10 amp at 250 v or 15 amp at 125 v, Harvey Hubbell, Inc. part no. 7082	368-0005-00
	CONNECTOR, PLUG, ELECTRICAL: 2 wire midget twistlock; 10 amp at 250 v, 15 amp at 125 v	368-0010-00
	ADAPTER, CONNECTOR: 3 contact, 2 prong plug, plastic dielectric; 15 amp at 125 v ac; Pass & Seymour, Inc. part no. 1919	368-0110-00

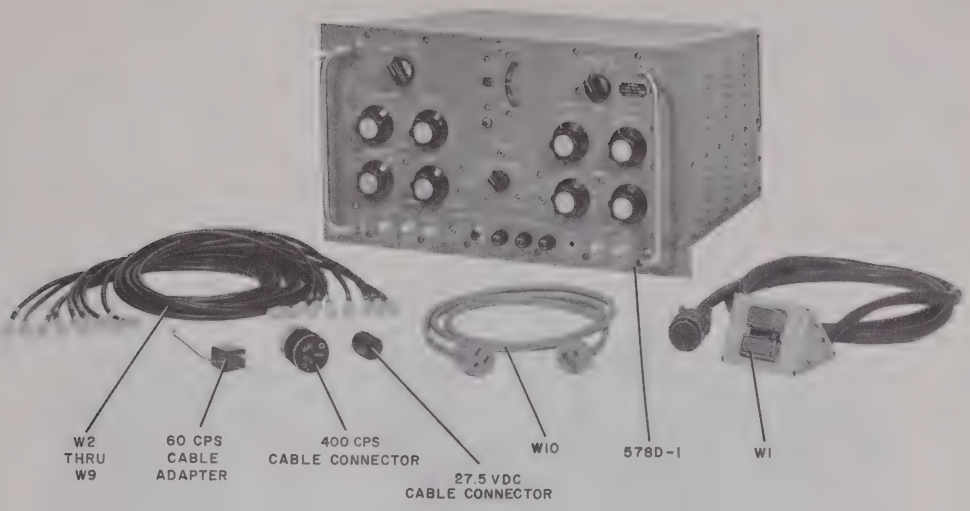


Figure 6-1. Over-all View with Cables Keyed

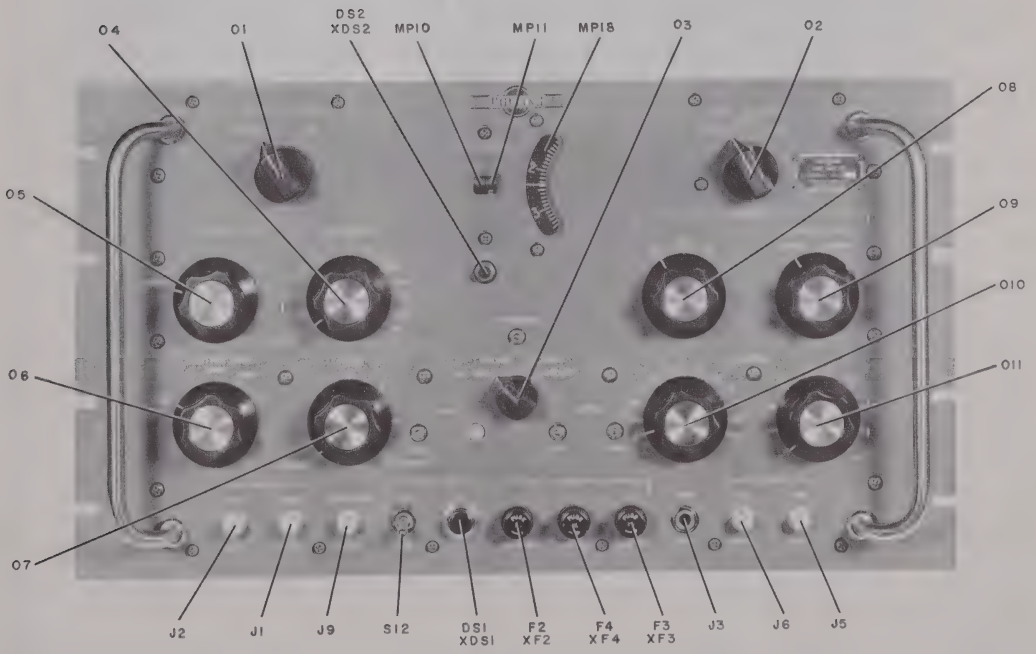


Figure 6-2. Front Panel with Component Identification

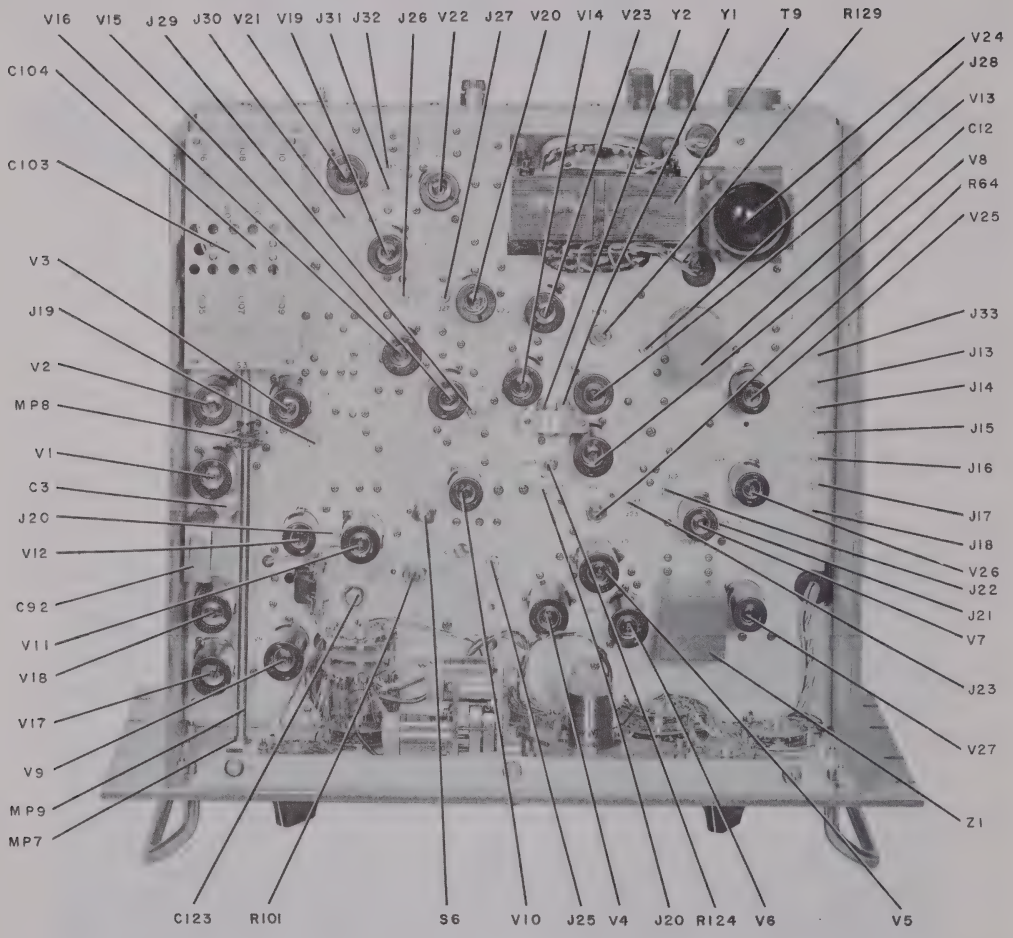


Figure 6-3. Main Chassis, Top View with Component Identification

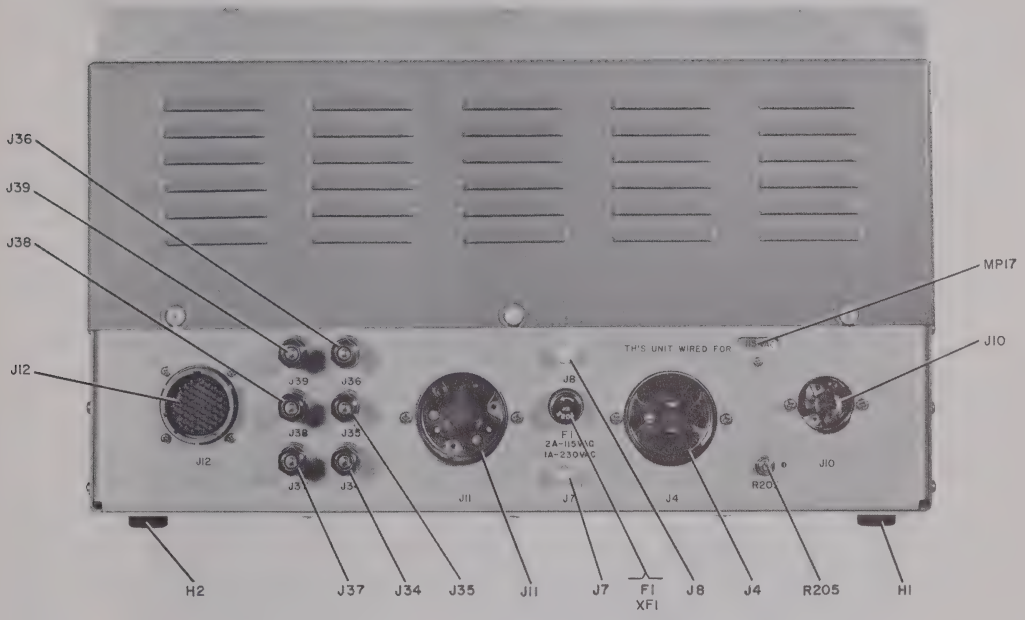


Figure 6-4. Rear View with Component Identification

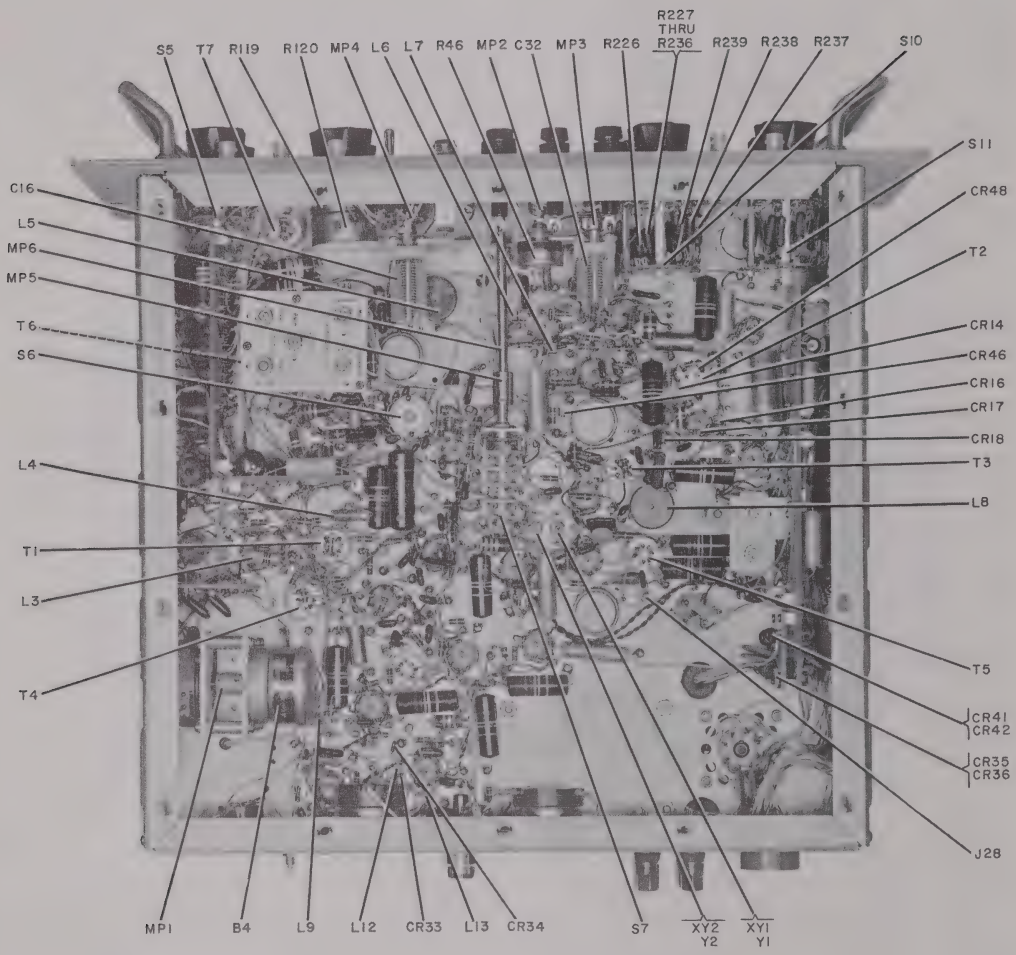


Figure 6-5. Main Chassis, Bottom View with Component Identification

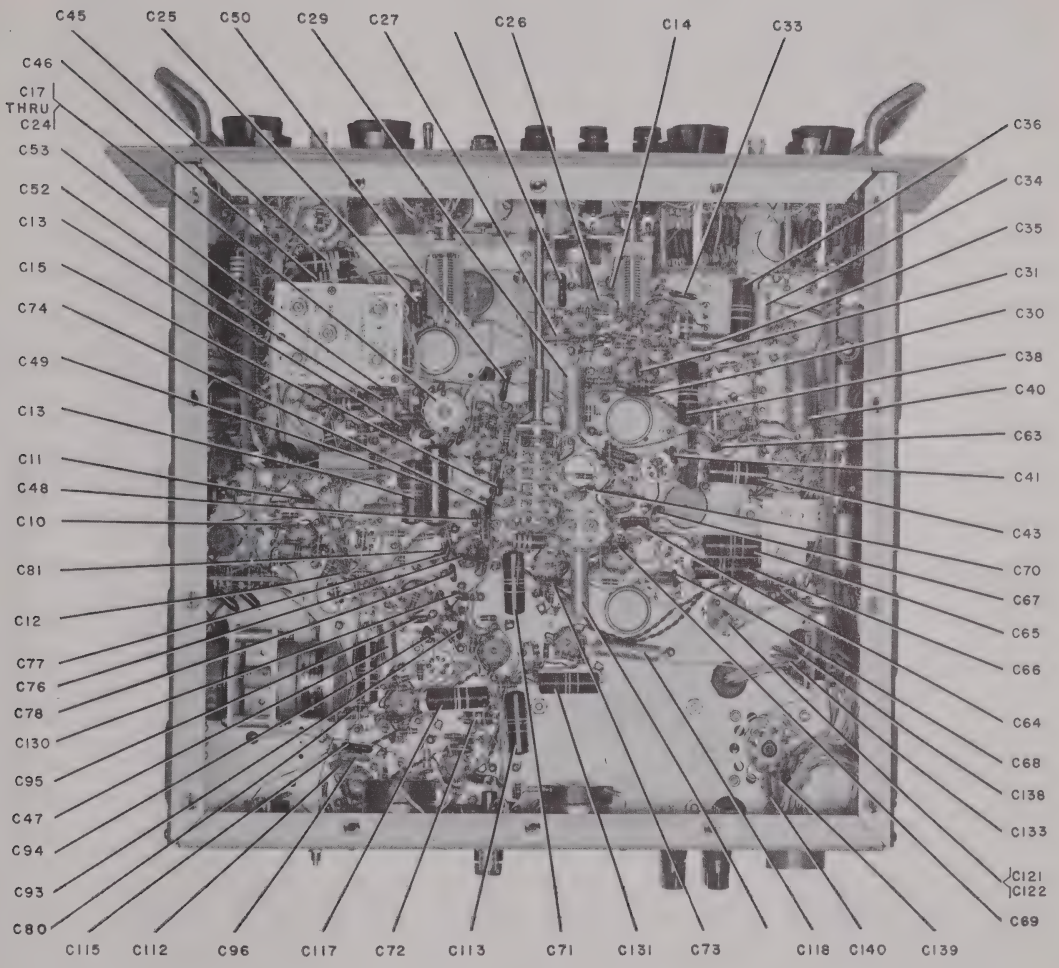


Figure 6-6. Main Chassis, Bottom View with Component Identification

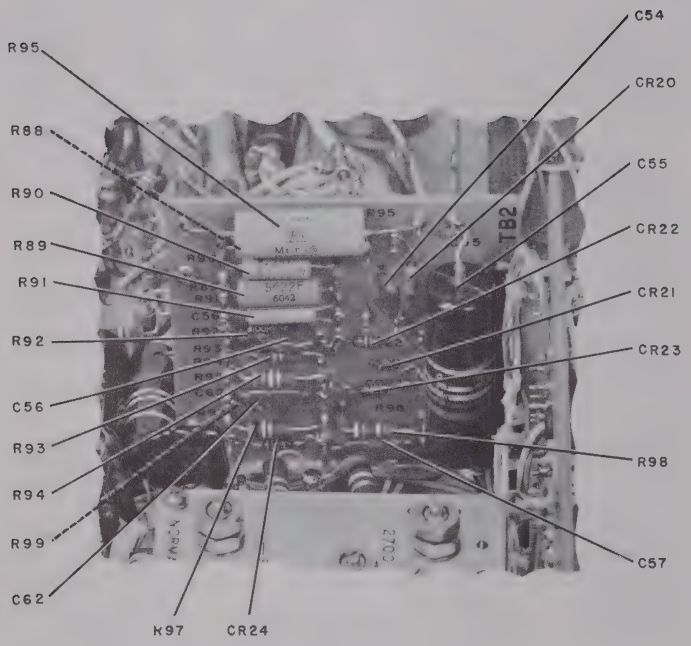


Figure 6-7. Main Chassis, Bottom View with Component Identification

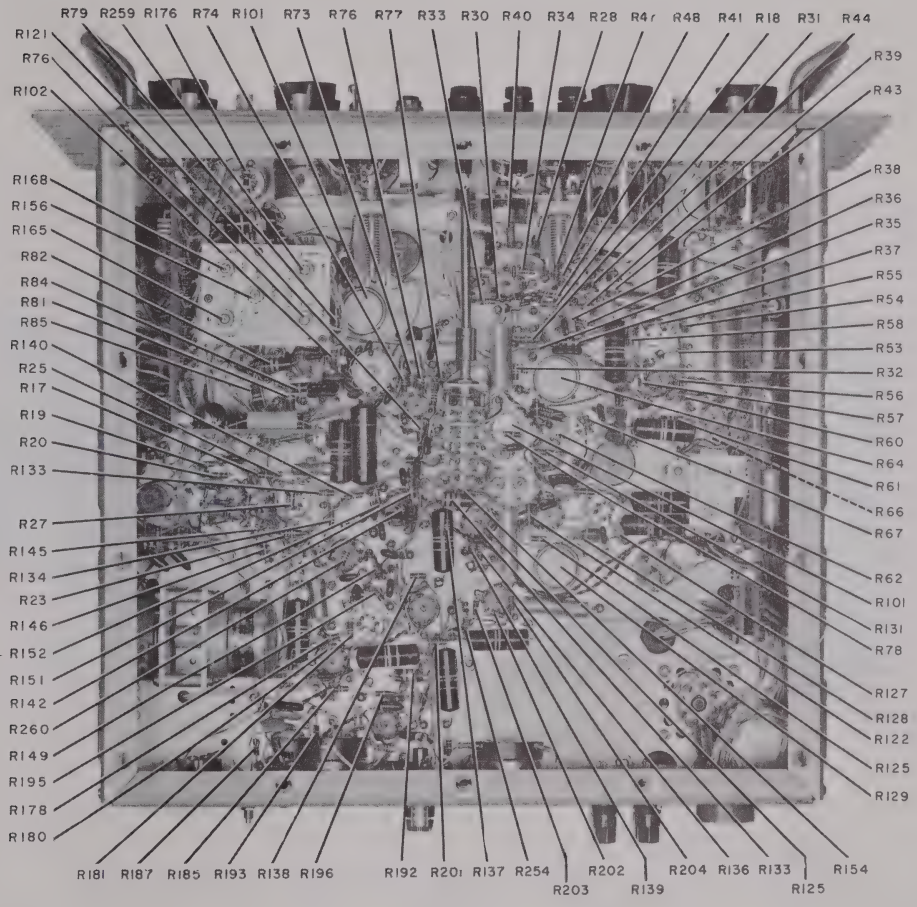


Figure 6-8. Main Chassis, Bottom View with Component Identification

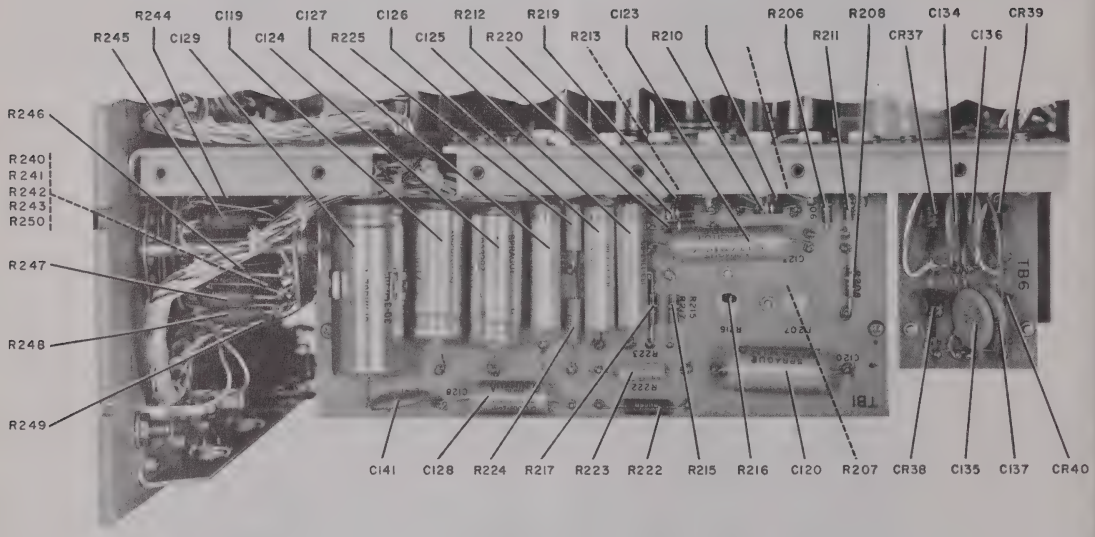


Figure 6-9. Right-Side View with Cover Removed and Component Identification

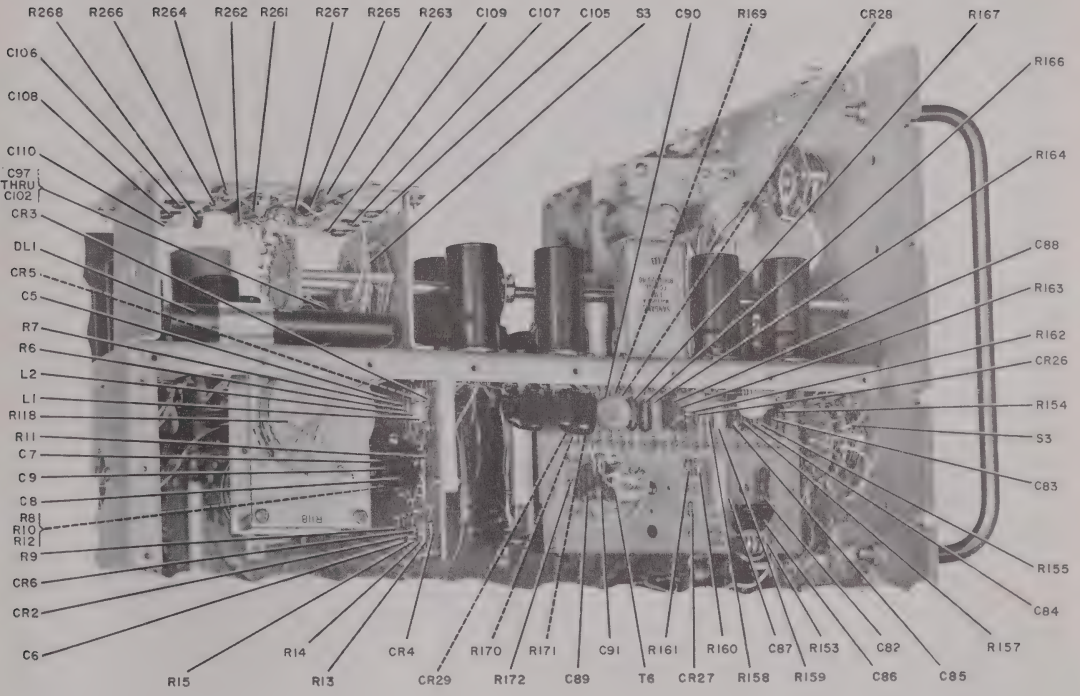


Figure 6-10. Left-Side View with Cover Removed and Component Identification

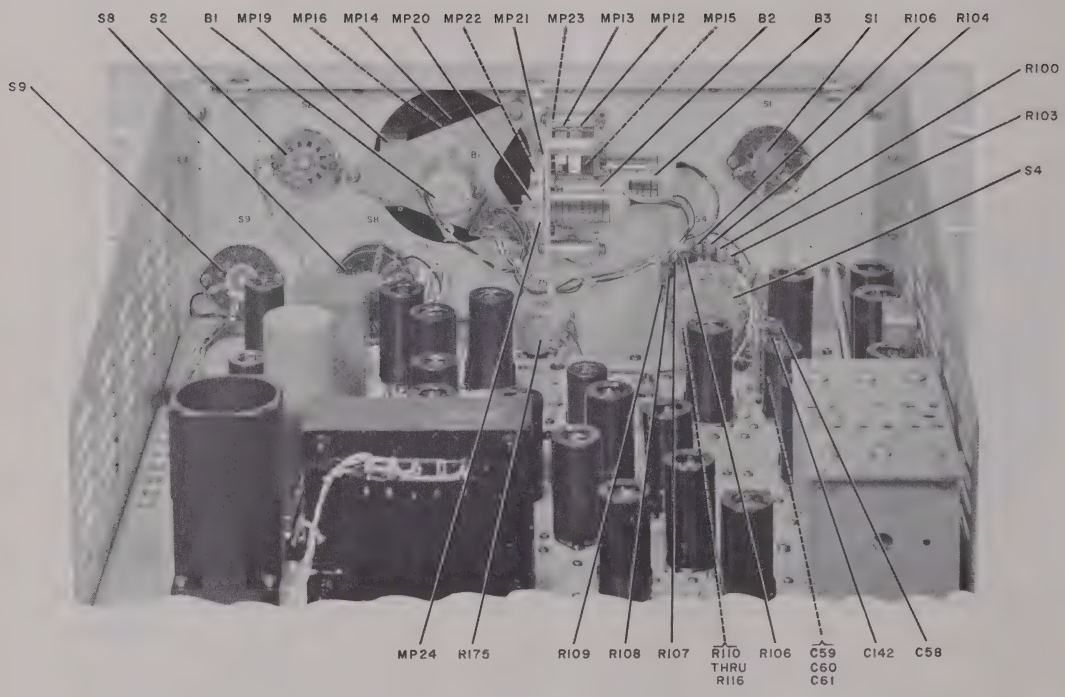
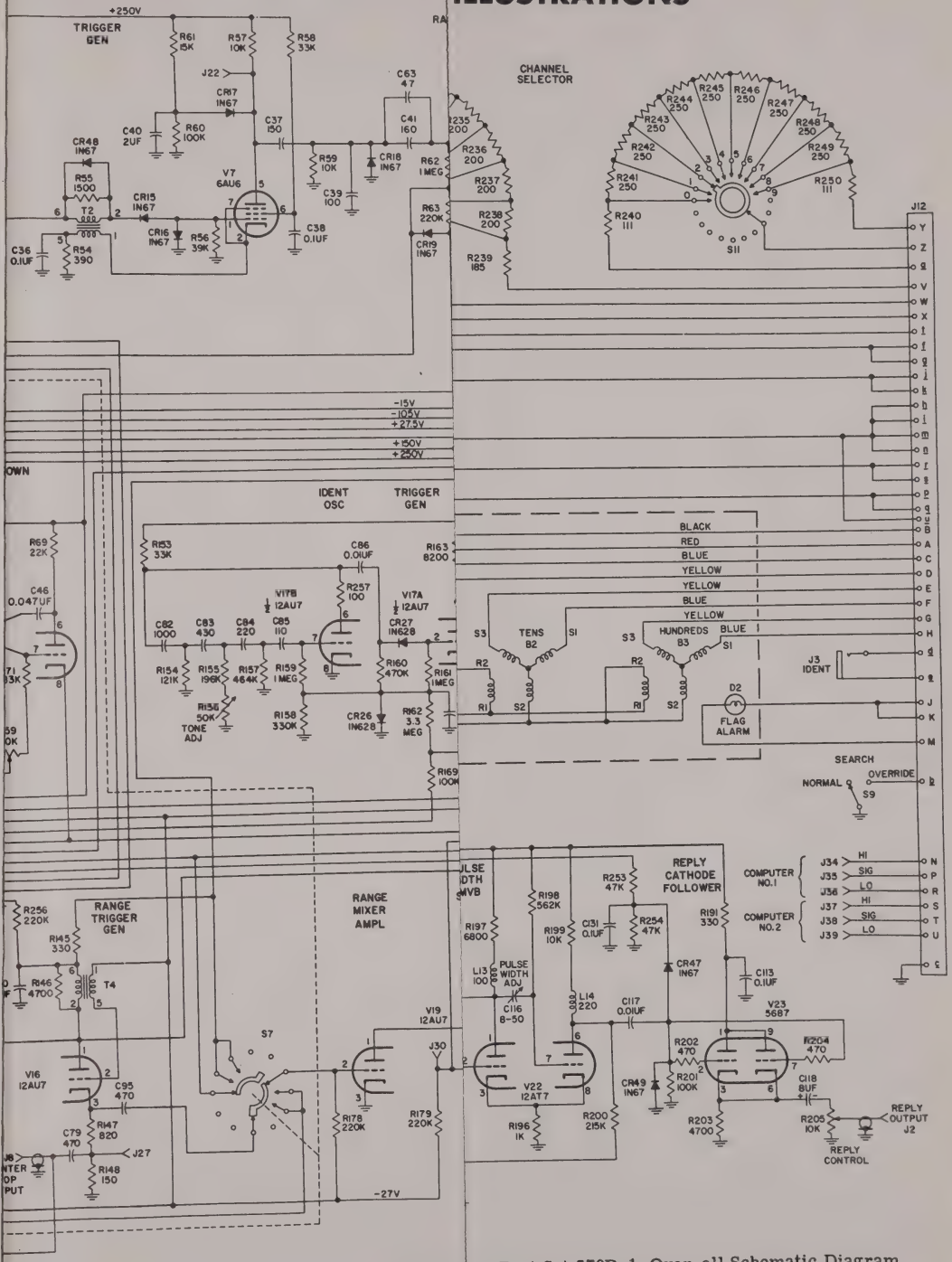
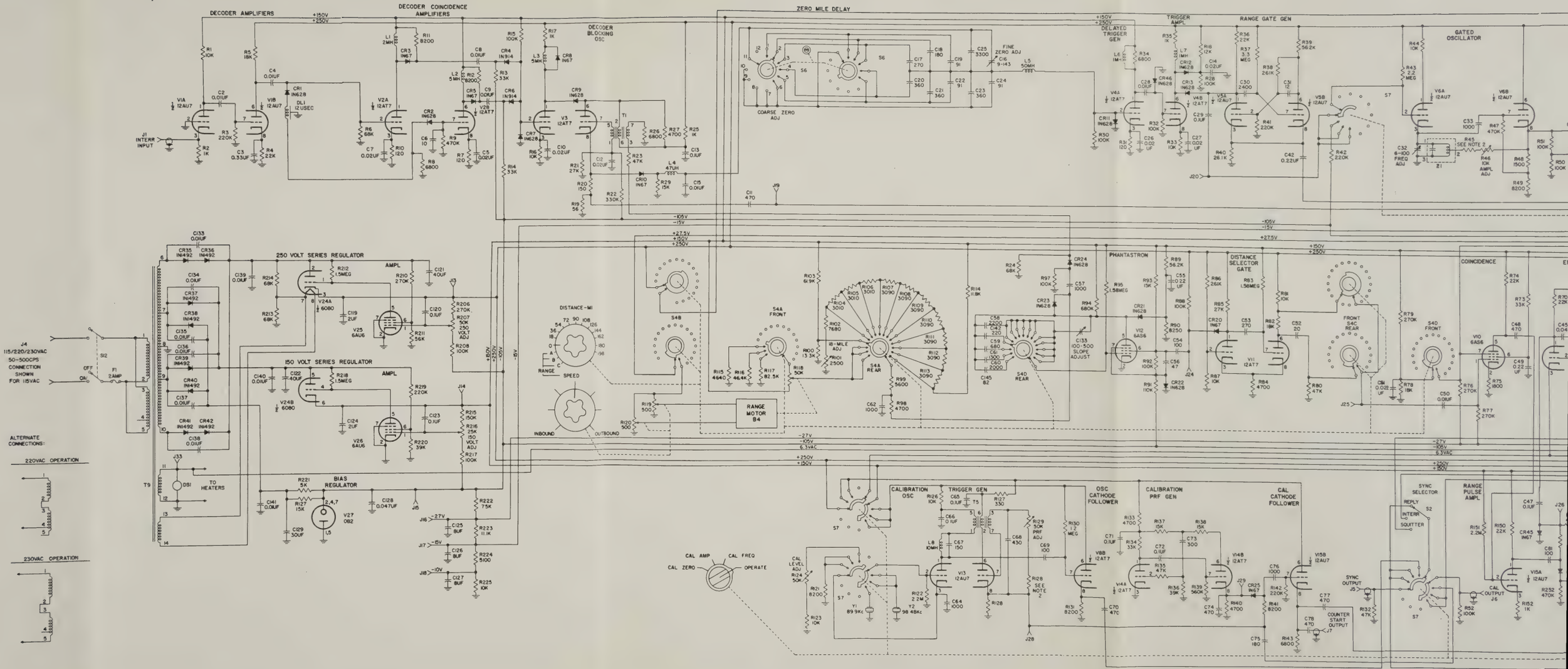


Figure 6-11. Front Panel, Rear View with Component Identification

SECTION VII
ILLUSTRATIONS



ch Test Set 578D-1, Over-all Schematic Diagram


DECODER AMPLIFIERS
DECODER COINCIDENCE AMPLIFIERS
DECODER BLOCKING OSC
ZERO MILE DELAY
COARSE ZERO ADJ
FINE ZERO ADJ
DELAYED TRIGGER GEN
TRIGGER AMPL
RANGE GATE GEN
GATED OSCILLATOR
250 VOLT SERIES REGULATOR
150 VOLT SERIES REGULATOR
AMPL
BIAS REGULATOR
TO HEATERS
DISTANCE-MI
RANGE
SPEED
INBOUND
OUTBOUND
RANGE MOTOR B4
18-MILE ADJ
PHANTASTRON
DISTANCE SELECTOR GATE
COINCIDENCE
FRONT
REAR
SLOPE ADJUST
CALIBRATION OSC
TRIGGER GEN
OSC CATHODE FOLLOWER
CALIBRATION PRF GEN
CAL CATHODE FOLLOWER
SYNC SELECTOR
REPLY
INTERR
SQUITTER
RANGE PULSE AMPL
SYNC OUTPUT
CAL OUTPUT
COUNTER START OUTPUT
CAL AMP
CAL FREQ
CAL ZERO
OPERATE
CAL LEVEL ADJ
ALTERNATE CONNECTIONS:
220VAC OPERATION
230VAC OPERATION
J1 INTERR INPUT
J4 115/220/230VAC 50-5000CPS CONNECTION SHOWN FOR 115VAC
SI2
F1 2AMP
DSI
T9
+150V
+250V
-105V
-15V
+27.5V
-27V
6.3VAC
+8V

SECTION VII
ILLUSTRATIONS

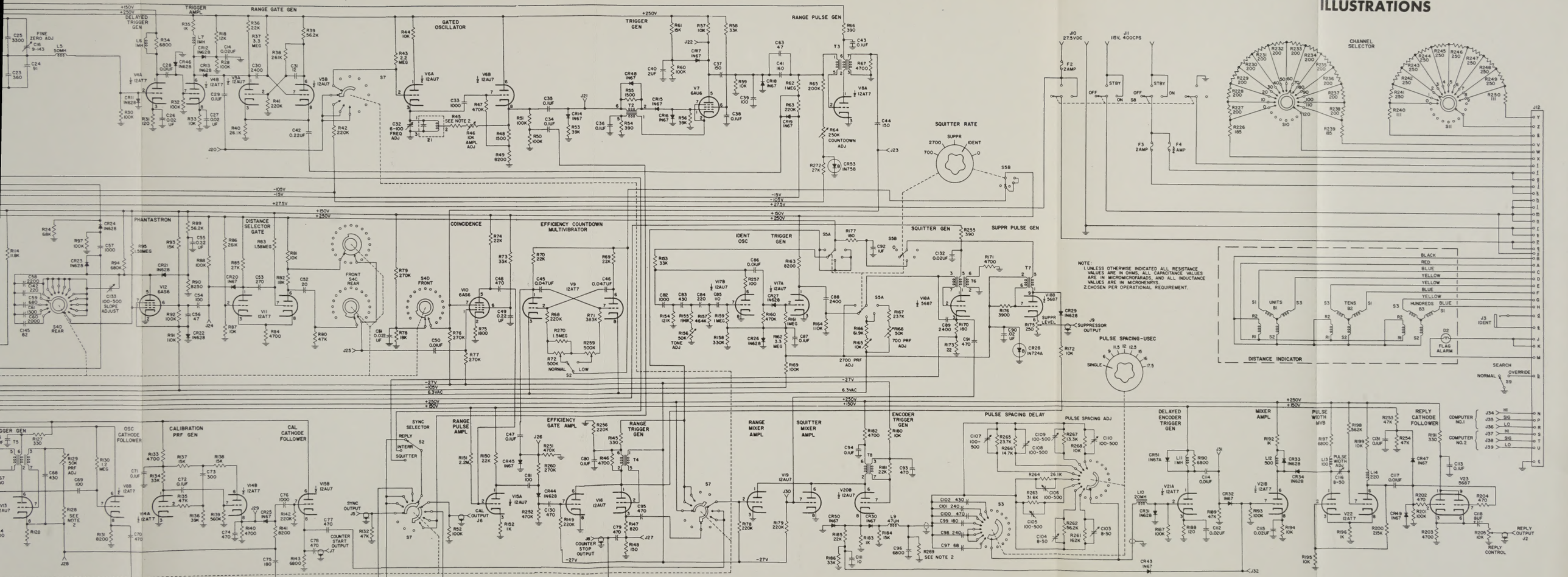


Figure 7-1. DME Bench Test Set 578D-1, Over-all Schematic Diagram

ELECTRICAL WIRE CODE

EXAMPLES

UNSHIELDED WIRE, MIL TYPE B #22 AWG, WHITE WITH RED AND GREEN TRACERS:

D	A	9	25	—	4-1/4
Type of Wire	Size of Wire	Color of Body	Color of Tracers		Length of Wire in Inches (Includes Stripping & Tinning)

SHIELDED WIRE (SINGLE), MIL TYPE C, #15 AWG, WHITE WITH RED AND GREEN TRACERS:

R	D	S	9	25	—	4-1/4
Type of Wire	Size of Wire	Shielded	Color of Body	Color of Tracers		Length of Wire in Inches (Includes Stripping & Tinning)

SHIELDED WIRE (MULTIPLE), MIL TYPE B, #22 AWG, WHITE, AND WHITE WITH RED TRACER:

D	A	S	(9)	(92)	—	4-1/4
Type of Wire	Size of Wire	Shielded	First Conductor	Second Conductor		Length of Wire in Inches (Includes Stripping & Tinning)

TYPE OF WIRE CODE		
LETTER	TYPE OF WIRE	FAMILY USUALLY FOUND IN
A	Cotton Braid Over Plastic (Formerly AN-J-C-48)	440 Plain 443 Shielded
B	Busbar, Round Tinned	421
C	MIL-W-16878 Type B (#20 and Larger) (600 Volts)	439
D	Miniature Wire, MIL-W-16878 Type B (#22 & Smaller)	439-7000 Series
E		
F	Extra Flexible Varnished Cambric	423
G		
H	Kel-F (Monochloro-trifluoroethylene)	422
J		
K	Neon Sign Cable (15,000 Volts)	423 0004 00
L	Silicone	425 0942 00
M		
N	Single Conductor Stranded (Not Rubber Covered)	422
P	Single Conductor Stranded (Rubber Covered)	423
Q		
R	MIL-W-16878 Type C (1000 Volts)	439 1000 Series
T	Teflon, MIL-W-16878 Type E (600 Volts)	439 4000 Series
V	MIL-W-16878 Type D (3000 Volts)	439 3000 Series
W	Teflon, MIL-W-16878 Type EE (1000 Volts)	439 0000 Series
X		
Y		
Z	Acetate Yarn Telephone Type	428

SIZE OF WIRE CODE	
LETTER	SIZE
A	#22 AWG
B	#20
C	#18
D	#16
E	#14
F	#12
G	#10
H	#8
J	#6
K	#4
L	#2
M	#1
N	#0
P	#00
Q	#000
R	#0000
T	#28
V	#26
W	#24
X	#19
Y	#30
Z	

COLOR CODE	
NUMBER OR LETTER	COLOR
0	Black
1	Brown
2	Red
3	Orange
4	Yellow
5	Green
6	Blue
7	Violet
8	Gray (Slate)
9	White
a	Clear
b	Tan
c	Pink
d	Maroon
e	Light Green
f	Light Blue

COLLINS RADIO COMPANY